A Dark Valley.
North Korea's Sinanju Munitions Plant:
A not-so Clandestine Uranium Enrichment Facility.

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18 June 2020

MAIN SOURCES:

The information presented below is used to support the statements offered above.

- The author of this paper assumes the reader is somewhat familiar with the Japanese atomic energy and research programs of the period 1938-1945. Some recommended sources:
    - Grunden, Walter E. Hungnam and the Japanese atomic bomb: Recent historiography of a postwar Myth. Intelligence and National Security. Volume 13, Issue 2, 1998
    - Grunden, Walter E. Secret Weapons & World War II, Japan in the Shadow of Big Science. University Press of Kansas. Wichita State University. 2005
    - Grunden, Walter E., Mark Walker and Masakatsu Yamazaki. Wartime Nuclear Weapons Research in Germany and Japan. *Osiris.* 2nd Series, Vol. 20, Politics and Science in Wartime: Comparative International Perspectives on the Kaiser Wilhelm Institute. 2005
    - Grunden, Walter E. From Hungnam to Yongbyon: Myths and Facts Concerning the Origins of North Korea's Nuclear Program. Associate Professor Department of History Bowling Green State University Bowling Green, OH. August 7, 2013
    - Rhodes, Richard. Dark Sun: The Making of the Hydrogen Bomb. Simon & Schuster. New York. 1995
    - Shapley, Deborah. THE JAPANESE A-BOMB. Nuclear Weapons History: Japan's Wartime Bomb Projects Revealed. 13 Jan 1978
    - Snell, David. Japan Developed Atom Bomb; Russia Grabbed Scientists. Constitution. Atlanta, Georgia. 3 Oct 1946.
    - Wilcox, Robert K. Japan's Secret War: Japan's Race against Time to build its Own Atomic Bomb. Marlowe & Company, New York. Copyright 1995
    - Wilcox, Robert K. Japan's Secret War: How Japan's Race to Build its Own Atomic Bomb Provided the Groundwork for North Korea's Nuclear Program. Third Edition: Revised and Updated – 10 December 2019
- The author of this paper and other projects concerning the Japanese atomic energy and research programs of the period 1936 -1945 are available free on the internet and include:
    - Rider, Dwight. Hog Wild-1945: The True Story of How the Soviets Stole and Reverse-Engineered the American B-29 Bomber. 2013.
    - Rider, Dwight R. and Eric DeLaBarre. Tsetusuo Wakabayashi, Revealed. 2014.
    - Rider, Dwight R. Burn before Reading: The Japanese Atomic Bomb Program, the Battles of the Chosin Reservoir, and the Cave at Koto-ri. The Cell. 2016
    - Dwight R. Rider, Dr. Eric Hehl and Wes Injerd. The "Kuroda Papers:" Translation and Commentary. 30 April 2017
    - Rider, Dwight R. Japan's Biological and Chemical Weapons Programs; War Crimes and Atrocities: Who's Who, What's What and Where's Where. 1928-1945. 3rd Edition. 14 November 2018
    - Rider, Dwight R. The Japanese Wartime Atomic Energy and Weapons Research Program – Seishin (Chongjin), northern Korea. 1938 – 1984. 22 March 2020

CAVEATS:

It is not the purpose of this work to re-write the materials presented by other authors in their publications

Where possible the lines and words contained herein are as they were found in existing publications, and are footnoted to the location where that line was copied to give its author full credit.

- Due to the liberal use of footnotes to source the materials used, quotation marks are rarely used
- Where information can be found in several different locations independently, no footnote is used
- A full bibliography of sources used is presented at the end of this document
- Readers are encouraged to fully access these sources

In conducting this research some caveats; warnings and cautions apply. Additional caveats may apply and readers are encouraged to submit suggestions

Nearly seventy-five years have passed since the Japanese nuclear energy and weapons research program was terminated through the invasion of Manchuria by forces of the USSR, US forces occupying Japan, and Chinese forces occupying formerly Japanese controlled territory in China

- We are forced to look at the program from the distance of time

The documentation surrounding the Japanese nuclear energy and weapons research program is incomplete for numerous reasons some of which include:

- Japanese documents captured and held by forces of the former USSR remain largely unavailable and untranslated
- Documents held in the US National Archives while publicly available, remain scattered through numerous record groups and boxes
    - While many such documents have been identified, it is likely that the location of many such documents remain unknown
- At the end of WWII, all Japanese military and many civilian industrial concerns were ordered to destroy all current documents and others then in archive
    - Many Japanese disobeyed the order
    - Occasionally documents stored for decades make their way back into public
- Though some documents have been released, the full status of documents held in the People's Republic of China remains undetermined

The Cold War (1947[?]-1991) has had an adverse impact on availability of information, its translation and acceptance.

- Cold War jargon is often found among post-WWII translations such as the terms; "Japanese War of Aggression," "imperialism," etc.

The Japanese government has historically sought to downplay the past in all areas of the war and pre-war period; further limiting the amount of information available concerning its nuclear energy and weapons research program

- The Japanese government and its military destroyed much of its official and archived documents in the days immediately following its surrender on 15 Aug 1945, leaving history with few official records to review.
- Because so many documents were destroyed by the Japanese at the end of the war, only a small window of official information exists which permits a view into the program

Some of the people, places and events listed in this document may not have been directly involved with Japan's nuclear energy and weapons research program

The information discussed herein is simply that; information, and not evidence

Any opinions expressed within the document are those of the author

This document was built with the assumption that its readers would have some understanding of nuclear energy and weapons research programs prior to their reading of the information contained herein

Research against Japan’s nuclear energy and weapons research programs continues

Much is made about the lack of US investigation into this subject immediately after the end of WWII. Postwar the US was only interested in the obvious; what happened at Pearl Harbor and to American POWs. The postwar Japanese military and government went to extreme efforts to hide the achievements and nature of their nuclear energy and weapons research program. They even established official offices to cover their trail. Almost a year passed from the end of the war until US investigators began to stumble upon, and understand the size of Japan’s program and its breadth. By the time US investigators realized the truth, the war had been over nearly two years; the Japanese had that much time to bury the past

The Dark Valley:
North Korea's Sinanju Munitions Plant.
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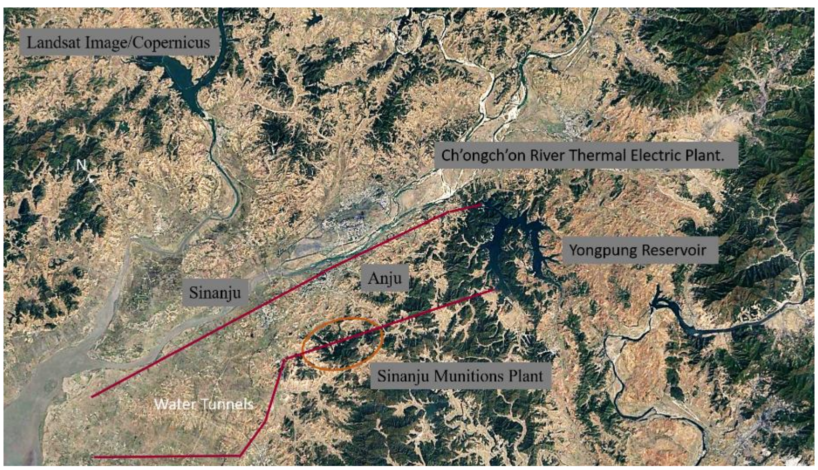
One of the longstanding questions concerning North Korea's uranium enrichment program is the possible use of an electromagnetic isotope separation (EMIS) system, to produce enriched uranium for a uranium-based weapons program. EMIS uses a great amount of electricity, is expensive and requires constant maintenance. It is however, relatively simple construct and the technology was declassified decades ago. It is fully capable of producing feedstock for North Korea's uranium centrifuge systems. In reviewing a timeline of nuclear developments within the DPRK a noticeable gap exists in the construction of nuclear-related facilities and the establishment of nuclear-related organizations during the 1970s and early-1980s. There have been previous announcements regarding the identification of such facilities, which were large, and met some of the criteria associated with EMIS, however this facility meets all criteria and bears signatures associated with EMIS.[1] That gap mentioned above no longer exists, suggesting that US estimates of North Korea's weapon's inventory are off, possibly by an order of magnitude.

North Korea's primary uranium enrichment installation is located 2.8 miles nearly due south of Anju, and 3.28 miles southeast of Sinanju in Pyongan Namdo Province, North Korea. Its North Korean name is not known, but is described as the Sinanju Munitions Plant in documents produced and released by the CIA dated January 1980. [2] The facility encompasses an area of about 9.34 square miles. 13.62 square kilometer and occupies about 3,500 acres or 1400 hectares of land. The CIA document also reveals the identification of a second installation, the Um-dong Munitions Plant. [3] It is unknown at this time whether the Um-dong Munitions Plant performs a similar function however, as the identification of the two date to the same period, it is possible they are related.



The installation as identified, the Sinanju Munitions Plant, contains an underground EMIS system, an underground centrifuge hall, and underground uranium hexafluoride storage site. Construction on the installation dates to 1938 (perhaps as early as 1919) under the Japanese Occupation of Korea (1904-1945).[4] What became known in 1979 to the CIA as the Sinanju Munitions Plant, was probably part of the earlier World War Two (WWII) era Japanese atomic energy and weapons research program. In my research it was this information that led to its identification. [5] It is unknown if the Chinese are aware of the plant, even though its underground waterworks were built during the Korean War with Chinese participation, but it is unlikely that they are. During WWII was probably the most secret of all Imperial Japanese atomic energy and weapons research uranium enrichment process locations, and more so for North Korea. The facility became operational at least 15 years before North Korean officials admitted to a highly enriched uranium (HEU) program to Assistant Secretary of State James Kelly in October 2002,

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[1] Landay, Jonathan. Exclusive: Possible early North Korean nuclear site found – report. WORLD NEWS. 21 JULY 2016. https://www.reuters.com/article/us-usa-northkorea-report-exclusive/exclusive-possible-early-north-korean-nuclear-site-found-report-idUSKCN1012WO

[2] New Munitions Plant Identified in North Korea. Imagery Analysis Report. National Photographic Interpretation enter. Formerly classified "SECRET." Sanitized Copy Approved for Release 2010/05/19: CIA-RDP80T00556A000100110001-3

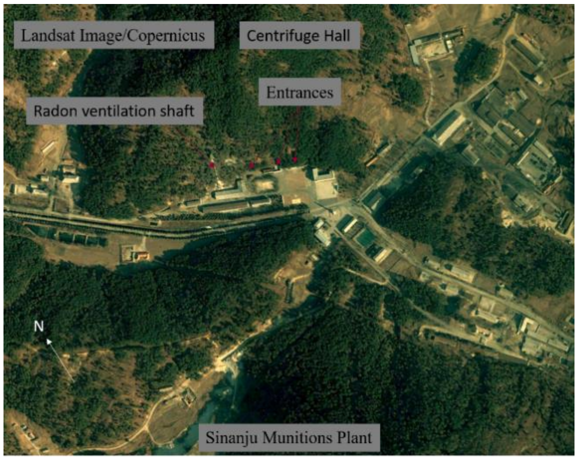
[3] New Munitions Plant Identified in North Korea. Imagery Analysis Report. National Photographic Interpretation enter. Formerly classified "SECRET." Sanitized Copy Approved for Release 2010/05/19: CIA-RDP80T00556A000100110001-3

[4] September 15, 1960, Journal of Soviet Ambassador to the DPRK A.M. Puzanov for 15-16 September 1960. Wilson Center. Digital Archive International History Declassified. digitalarchive.wilsoncenter.org

[5] Irrigation Works, Pyongan Namdo. KMAG (Korea Military Advisory Group) Liaison Office. 4302. 0300. North Korea. TB 2582 4671. T. I, G-2, Headquarters, Far East Command. Confidential Informant. 10 December 1949. Bibliographic ID (link to National Diet Library Online) digidepo_3540683 pdf-Anju

implying that US estimates concerning the quantity of the country's arsenal is much higher than presently admitted. [6] The facility predates Iraqi EMIS efforts. suggesting that Saddam Hussein's ties to Pyongyang were more involved with receiving information concerning EMIS development and operations, than in transmitting such information to North Korea. As for North Korea admitting it had a HEU program…

Eventually there was some backpedaling on this story, but it took over a year. Here is how Barbara Slavin and John Diamond framed the backtracking in an astonishing piece written for USA Today: "A year after North Korea provoked a crisis with the United States by admitting a secret effort to make weapons-grade uranium, US officials say the program appears to be far less advanced than diplomats had feared.... A US intelligence official says the CIA, which has conducted extensive surveillance of North Korea, is 'not certain there even is' a uranium enrichment plant. He says North Korea may have overstated its capability as part of a strategy of 'bluff and bluster to extract concessions from the United States…." The reason it's still unclear whether there is a uranium program is that such efforts are difficult to monitor. [7] There was a program alright, and it centered on the Sinanju Munitions Plant but no one had recognized the facility for what it was: An EMIS and centrifuge operation.



The North Korean nuclear program is 75 years old. It was established before the independent North Korean state in the immediate aftermath of WWII. It precedes international negotiations over the nuclear non-proliferation and the formation of the nuclear non-proliferation regime in the mid-1960s, as well as the establishment of the International Atomic Energy Agency and its safeguards regime in the early 1970s. It is older than the nuclear programs of the quasi-nuclear states of Israel, India, and Pakistan, let alone such former short-lived nuclear hopefuls as South Africa, Brazil, and Argentina. Those who think otherwise delude themselves. It was built on the remnants of the Japanese atomic energy and research programs of WWII.

Historically, construction on Japan's largest uranium enrichment project began under the cover of the Showa Shu Ri Kumiai (Showa Water Utilization Society). [8] After the Korean War, the Korean Communist Party defined the main goals of its proposed technical revolution to be irrigation, electrification and mechanization. The irrigation of large tracts of farm land was its first target. [9] As the irrigation of North Korea succeeded this goal would be replaced with chemicalization. Large-scale water irrigation projects would provide the cover story for most of North Korea's uranium enrichment sites for the next 65 years. There was never any "tube alloys," "S-1" or "rocket fuels project" used by North Korea to hide its uranium enrichment program, just good old run-of-the-mill irrigation.

Mass campaigns, Levée en masse and other large-scale worker mobilization programs would hide in-the-open, North Korea's clandestine enrichment program. Cement, steel, all the requirements of over-production to meet the needs of the country's uranium weapons projects could be hid under the umbrella of irrigation. There was nothing to see here and – no one looked. Irrigation became the cover term for all matters nuclear. They would later work on an irrigation project in Nyongbyon (Yongbyon) even though its first nuclear research reactor was supplied by the Soviet Union and was openly known. Old habits die hard. During his entire 45 years as leader of North Korea, there was hardly a month which went by where Kim Il-sung did not mention North Korea's irrigation projects. The best way to hide North Korea's uranium enrichment programs was to direct attention to its cover. It was brilliant. The Showa Water Utilization Society was organized in 1938, nearly in-tandem with Otto Hahn's discovery of fusion in

[6] Niksch, Larry A. North Korea's Nuclear Weapons Program. Congressional Research Service Report for Congress. Congressional Research Service, The Library of Congress. 7 April 2006

[7] Slavin, Barbara and John Diamond. "N. Korean Nuclear Efforts Looking Less Threatening." USA Today. 4 November 2003

[8] Irrigation Works, Pyongan Namdo. KMAG (Korea Military Advisory Group) Liaison Office. 4302. 0300. North Korea. TB 2582 4671. T. I, G-2, Headquarters, Far East Command. Confidential Informant. 10 December 1949. Bibliographic ID (link to National Diet Library Online) digidepo_3540683 pdf-Anju

[9] Development of Science and Culture. I, Basic Tasks of the Seven-Year Plan. II, Far Reaching Prospects. Report to the Work of the Central Committee to the Fourth Congress of the Workers' Party of Korea. 11 September. 1961. contained in Kim Il Sung. Works. Volume 15. January – December 1961. Foreign Languages Publishing House. Pyongyang, Korea. 1983

Germany. Hahn began work on radioactive transmutation products in 1934 at the Kaiser Wilhelm Institute for Chemistry with Lise Meitner and his student, Fritz Strassman.

Fission:

In late 1938 Hahn, Meitner and Strassman had found evidence of isotopes of an alkaline earth metal in the results of their earlier experiments. The presence of an alkaline earth metal did not logically fit with the other elements found thus far. The metal was initially thought to be radium produced by splitting off two alpha-particles from the uranium nucleus. At the time, the scientific consensus was that splitting off two alpha particles via this process was thought unlikely. On 10 November while visiting Copenhagen, to lecture at Niels Bohr's Institute, Hahn discussed these early results with Niels Bohr, Lise Meitner, and Otto Robert Frisch. [10] Further refinements of his experiments lead to the decisive experiment producing nuclear fission on 16–17 December 1938. The results of the experiment produced puzzling results: three isotopes that consistently behaved not as radium, but as barium. Hahn, who did not inform the physicists in his institute of the results, described his findings exclusively in a letter to Meitner on 19 December 1938. It was Lise Meitner and Otto Robert Frisch who identified Hahn's results as fission. On 22 December 1938, Hahn sent a manuscript to *Naturwissenschaften* reporting their radiochemical results, which were published on 6 January 1939. It is unlikely that the Japanese were aware of Hahn's ongoing efforts. The Japanese were conducting their own experiments.

The Imperial Japanese Navy was the first known branch of the Japanese government to express interest in a nuclear weapon. The navy was keen to find a new source of propulsion for its capital ships as well as a powerful new weapon. Its modest investigation of 1934, conducted under its B-Research Program, concluded that nuclear weapons were not feasible at that time. [11] A parallel program, Project A was centered on the development of radar. [12] The projects were otherwise known as A-Research or B-Research. B-Research was the world's first military atomic energy and weapons research project. Neither Nishina Yoshio, the chief of theoretical physics for many of Japan's atomic weapons programs, or Iimori Satoyasu who led most of Japan's wartime searches for uranium ore, attended the meeting and were never involved in Project A or Project B. Subsequent intelligence reports would eventually force Japan into taking further action on the issue of weapons based upon uranium.

In 1939, a rumor spread among top Imperial Japanese Navy officers that US scientists in California had succeeded in powering a small turbine with nuclear energy. Where the rumor started is unknown but likely to have had its origins in the research then ongoing at the University of California at Berkeley under Ernest Lawrence. The university's 27-inch cyclotron was superseded by a 37-inch cyclotron in June 1937 and its work at the time may have led to the confusing rumors then running amok in Japan a year or so later. This, together with reports of a US embargo on uranium exports, convinced leaders of the Imperial Japanese Navy to take action. The navy was already keen to find a new source of propulsion for its capital ships as well as powerful new weapons.

By mid-1939 Japanese scientists along with most other physicists throughout the world had recognized the potential of Otto Hahn's discovery of fission. Within uranium-235 ($U^{235)}$ lay vast potential energy. Many also saw in fission the potential for a weapon of tremendous power. They also realized that to obtain sufficient amounts of U^{235} to develop such a weapon, large amounts of uranium bearing ores would need to be located (looted), mined (stolen) and enriched. The acquisition or uranium was the first major obstacle any nation would have to overcome in producing an atomic weapon. The US and Britain had overcome the hurdle by acquiring such ores from the Belgian Congo, Canada and in the state of Colorado in the US. Through the war Japan would acquire a vast amount of territory and raw material that its industrial base would convert into finished goods for sale within the Empire, or in support of its thinly spread military forces abroad. The same would hold true for the uranium ores it found in Burma, China, Korea and Malaysia. The ores found in East Asia would be shipped to Japan for initial processing. Like the US Manhattan Project, the U^{235} in these ores would be separated out through some enrichment process using large industrial-type installation much like those of the Manhattan Project.

As with the US Manhattan Project, Japanese scientists and engineers explored several uranium enrichment technologies. Production plants employing four different uranium enrichment processes – EMIS, liquid thermal

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[10] Sime, Ruth Lewin. "Lise Meitner's escape from Germany". American Journal of Physics. 58. 1990

[11] Mun-Keat Looi Genshibakudan to Genshiryoku: Japan and nuclear science. 3 August 2015 https://medium. com/@ayasawada/genshibakuden-to-genshiryoku-japan-and-nuclear-science-d59538884d6f#. 7439skj1x

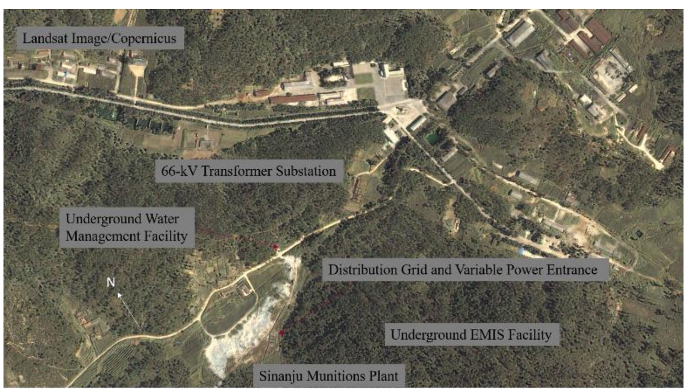
[12] The Pacific War Research Society. The Day Man Lost: Hiroshima, 6 August 1945**.** Kodansha International. Tokyo, Japan. 1981

diffusion, gaseous diffusion and centrifuges – were either constructed or under construction on the Korean Peninsula from 1940 to 1945. The Showa Shu Ri Kumiai south of Anju was to be one of them. There were others.

Though construction began in 1938, little was accomplished. It is likely that with Japan's 1937 war in China resulting initially with large victories, the country's leadership thought the project of little consequence. The beginning of war in the Pacific and Japan's early victories in 1941 may also have added to slow progress in constructing the installation. Long-term military programs always suffer when placed under the intense scrutiny of budgetary considerations. The Showa Shu Ri Kumiai south of Anju was no different. Progress on other large uranium enrichment installations, such as those at Hungnam, were proceeding rapidly. Besides, the Hungnam installation, based upon thermal diffusion, was far less expensive than the Showa Shu Ri Kumiai. Worse yet, as the Showa Shu Ri Kumiai would support an EMIS system, the expense was even greater.

EMIS:
EMIS uses large magnets to separate ions of the uranium isotope, U^{235} from the more prevalent U^{238}. The EMIS process is based on the same physical principle as that of a simple mass spectrometer – that a charged particle will follow a circular trajectory when passing through a uniform magnetic field. Two ions with the same kinetic energy and electrical charge, with the heavier 238 U + ion having the larger diameter but different masses (i.e., 235 U + and 238 U +), will have different trajectories. The different trajectories of the two uranium ions allow for the separation and collection of the material in receivers or "collector pockets." EMIS is a batch process that can produce weapons-grade material from natural uranium in only two stages. However, hundreds to thousands of units would be required to produce large quantities of HEU due of the process's relatively low product collection rate, and the long cycle time required to recover material between runs.

The of EMIS process was developed in the United States as a part of the Manhattan Project. Concurrent technologies required for EMIS include: 1) Large electromagnets, 2) High voltage power equipment, 3) High current ion sources, 4) Vacuum/molecular diffusion pumps, 5) UCl^4 processing equipment and 6) uranium processing equipment. During WWII in the Pacific, Japan is known to have begun construction of a large EMIS of 180^0 deflection for uranium separation but the war interrupted its completion. [13] Work on a Soviet EMIS enrichment process in Russia began at the Kurchatov Institute of Atomic Energy in 1943 when the institute was founded and was directed by L.A. Artsimovitch, I.N. Golovin and G.Ia. Shchepkin. [14] The first tests of the EMIS process in the Soviet Union were conducted in 1946 with the help of an electromagnet liberated from Germany. The technology is attractive to fledgling nuclear states because it is relatively quick to develop and place into operation, requiring as little as three years from construction start to operations. In 1941 using already existing cyclotrons to demonstrate the technology, the US decided to build bigger machines called "calutrons" to produce enriched uranium. Calutrons produced the first HEU, using slightly enriched uranium from other processes as feedstock. When the first gaseous diffusion plant began operating effectively, the use of calutrons for enriching uranium ceased. They were, however, used for other isotopic separation tasks.



All information concerning the US Manhattan Project's EMIS efforts were declassified shortly after World War Two. The technical details of the American calutron program were declassified in two steps. First, a series of fundamental research reports appeared in division I (Electromagnetic Separation Project) of the US National Nuclear Energy Series between 1949 and 1952. Second, a collection of specialized reports was declassified and started to appear towards the end of 1955 (Technical Information Service, Oak Ridge, Reports number TID-5210 to TID-5219). This was the era of the "Atoms for Peace" program and it was thought that, apart from their scientific

[13] Erkman, Suren. Andre Gsponer, Jean-Pierre Hurni, and Stephan Klement. The origin of Iraq's nuclear weapons program: Technical reality and Western hypocrisy. Independent Scientific Research Institute. Geneva. Switzerland. 20 October 2008
[14] I. Golovin, Rossiiskii nauchnyi tsentr-Kurchatovskii institut, unpublished manuscript, 1992.

applications and potential to produce small amounts of separated isotopes for industrial and medical use, no country would ever turn to EMIS to produce the relatively large amounts of enriched material needed for atomic weapons due to its high demands for electrical power. They were largely correct, that is until smaller and poorer nations began to seek nuclear weapons and sought an HEU process. The first was North Korea, the second was Iraq. Of all the known uranium separation processes EMIS is the most certain to produce at least some fissionable material, albeit not very efficiently.

The main reason for declassifying information concerning the EMIS process was is that it involved no scientific or technological principle that could be effectively protected by a patent or kept secret. The principles of EMIS were common to several similar techniques which included mass spectroscopy, momentum spectrometry, electron microscopy and circular accelerator technology. EMIS was also an important tool for fundamental research in nuclear physics (where it is essential for separating the various isotopes of a natural element in order to study their properties). All major components of an EMIS system (ion sources, magnets, vacuum system, high voltage power supplies etc.) were widely used in all research laboratories which use low or high energy particle accelerators to study nuclear reactions or the interactions of elementary particles.

In the uranium EMIS process, uranium ions are generated within an evacuated enclosure (called a “tank”) that is located in a strong magnetic field. For the EMIS ion source, solid uranium tetrachloride (UCl^4) is electrically heated to produce UCl^4 vapor. Uranium tetrachloride (UCl^4) is used as feedstock in the EMIS process. Uranium tetrachloride is produced by the reaction of carbon tetrachloride (CCl^4) with pure UO^2 at 700 °F. Nearly all uranium enrichment plants rely on UF^6 as their initial input material.

UF^6 emits low levels of radiation. Released into the atmosphere where it can mix with moisture it will produce uranyl fluoride (UO^2F^2) and hydrofluoric acid (HF). The reaction is instantaneous. Exposed to air a UF^6 release is visible as a white fog. HF is also detectable by its smell. As a heavy metal, uranium can also have toxic effect primarily affecting the kidneys. In high enough concentrations, as an acid it can damage the skin and lungs to the point of death. Released in an underground facility, regardless of any well-planned ventilation, the occupants of the facility were likely to suffer some ill-effects. People unable to immediately escape, those remaining in an underground facility experiencing a major failure, would be incapacitated.

The UCl^4 molecules are bombarded with electrons, producing U^+ ions. The ions are accelerated by an electrical potential to high speed and follow a circular trajectory in the plane perpendicular to the magnetic field. In the US EMIS separators, the ion beam traversed a 180-deg arc before the ions pass through slit apertures at the collector. A major problem with the EMIS process is that less than half of the UCl_4 feed is typically converted to the desired U + ions, and less than half of the desired U + ions are actually collected. Recovery of unused material deposited on the interior surfaces of the tanks is a laborious, time-consuming process that reduces the effective output of an EMIS facility and requires a large material recycle operation.

In the US EMIS program, production of weapons-grade uranium took place in two enrichment stages, referred to as the a (alpha) and b (beta) stages. The first (a) stage used natural or slightly enriched uranium as feed and enriched it to 12 to 20 percent U-235. The second (b) stage used the product of the (a) stage as feed and further enriched it to weapons-grade uranium. To allow more efficient use of magnets and floor space, the individual stages were arranged in continuous oval or rectangular arrays (called “race-tracks” or, simply “tracks”) with separator tanks alternated with electromagnetic units. The US EMIS separators are referred to as “calutrons” because the development work was carried out at the University of California (Berkeley) during the early 1940’s using cyclotrons (California-U).

EMIS Forgotten:
An EMIS facility could be attractive for a country desiring a limited weapons-grade uranium enrichment program. All five of the earliest nuclear weapons states tested or used the EMIS process for uranium enrichment. The process might be especially appealing as a method for further enriching partially enriched material. It has been well documented that EMIS was the principal process pursued by the Iraqi uranium enrichment program. Iraq’s first industrial-scale EMIS facility was constructed in Tarmiya, 40 kilometers northwest of Baghdad. A second facility was constructed at al Sharqat, 200 kilometers northwest of Baghdad. The two plants were to be identical with a total of 70 alpha-calutrons and 20 beta-calutrons each. The 70 alpha separators were to be installed in two large (5 m by 60 m) parallel piers with 35 separators in each line.

This took place at a time when EMIS had been discarded and largely forgotten as a method for uranium enrichment because it is both energy intensive and labor intensive, and it is not economically competitive with other enrichment technologies. North Korea's EMIS is probably used to provide feed stock for its uranium enrichment centrifuges. The largest drawback of EMIS is that it requires an enormous amount of electricity. Its main disadvantage is that it is not a continuous process but a batch process. Such an installation could not be operated in prewar Japan in peacetime not to mention wartime. Nor could it be operated in any of Japan's wartime territories. It could only be operated in one area under Japanese control, and that area was Korea.

Accurate figures are difficult to acquire for either Germany or Japan during the war however some comparisons can be made. In 1939 Germany produced 86 billion kilowatt-hours (kWh) of electricity. In 1943 Japan produced 38.4 billion kWh, less than half that of Germany. [15] Roughly 80 percent of the power produced in Germany was derived from coal-burning thermoelectric plants while 20 percent of its electricity was derived from hydroelectric plants. [16] In Japan the near exact opposite was true with 80 percent of its power derived from water power and the remainder derived from coal.

Unlike Germany, Japan lacked large coal reserves and relied almost entirely upon rivers for electrical power generation. The opposite was true for Germany which lacked access to water resources similar to those of Japan but had tremendous coal reserves. Note that for the processing of uranium hydroelectric plants provide a more stable source of power than do thermoelectric plants. In North Korea, the hydroelectric power is provided by power stations located along the Yalu River and elsewhere, nearly all built by Japan during the Japanese Occupation of Korea. Great fluctuations or the complete loss of power to the equipment used for most uranium enrich processes during operations could damage or otherwise destroy sensitive enrichment equipment. For example: The Stuxnet worm attack on Iranian nuclear facilities caused the loss of 984 centrifuges. [17] If not destroyed such equipment would require some level of clean-up before a process underway at the time power was lost could be restarted. Any loss of power for only a few seconds could result in cleanup operations lasting several days or even weeks. In 1956, 96 percent of North Korea's electrical power capacity rested in hydroelectric power. [18]

Natural Resources:
In 1911 the Korean Governors-General initiated an investigation into the natural resources available on the peninsula. Completed in 1914 the study revealed that the peninsula possessed a potential hydroelectric power generation capacity of only 57,000 kilowatts. [19] According to the study, the chief obstacle hindering development of the hydroelectric resources available was the highly variable periods of drought and flooding that plagued the peninsula. A second survey conducted from 1922 to 1926 arrived at a higher potential figure of 2,250,000 kilowatts generated mostly from hydroelectric resources. [20] The higher potential capacity was derived by considering new techniques such as the use of larger reservoirs, higher dams, aqueducts and water tunnels to redirect stored water to power generation plants. [21] It was Korea's electrical power capacity which allowed Japan to pursue an atomic bomb at all.

Subsequent studies raised the estimated potential capacity of the peninsula to a figure in excess of 5,000,000 kilowatts. [22] These later studies estimated that another one million kilowatts could be generated from plants located along the Yalu River. [23] It was further estimated that tidal plants, taking advantage of the extreme tides along the western coast of the peninsula including the area of Jinsen (Inchon), could add another one million kilowatts to the

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[15] Thomas E. Griffith Jr. "Strategic Attack of National Electrical Systems." Air University Press. Maxwell Air Force Base, Alabama. October 1994. http://www. scribd. com/doc/1434041/US-Air-Force-griffith
[16] Thomas E. Griffith Jr. "Strategic Attack of National Electrical Systems." Air University Press. Maxwell Air Force Base, Alabama. October 1994. http://www. scribd. com/doc/1434041/US-Air-Force-griffith
[17] Holloway, Michael. Stuxnet Worm Attack on Iranian Nuclear Facilities. 16 July 2015 http://large.stanford.edu/courses/2015/ph241/holloway1/
[18] The Electric Power Industry of North Korea. Provisional Intelligence Report. CIA/RR PR-148. (ORR Project 27.8789). Office of Research and Reports. Central Intelligence Agecny. 21 September 1956
[19] Grajdanzev, Andrew J. Modern Korea. International Secretariat, Institute of Pacific Relations. The John Day Company. New York. 1944
[20] Grajdanzev, Andrew J. Modern Korea. International Secretariat, Institute of Pacific Relations. The John Day Company. New York. 1944
[21] Grajdanzev, Andrew J. Modern Korea. International Secretariat, Institute of Pacific Relations. The John Day Company. New York. 1944
[22] Grajdanzev, Andrew J. Modern Korea. International Secretariat, Institute of Pacific Relations. The John Day Company. New York. 1944
[23] Grajdanzev, Andrew J. Modern Korea. International Secretariat, Institute of Pacific Relations. The John Day Company. New York. 1944

total potential power generation capacity of the peninsula. [24] North Korea would later follow this line of electrical power expansion.

In the years following these reports the Japanese began installing small-scale powerplants across the peninsula, nearly all thermoelectric making use of the available coal. By the late 1920s the country produced about 50,000 kilowatts; 13,400 kilowatts from hydroelectric plants and 34,500 kilowatts from thermal sources to include coal. [25] As North Korea later found, such small-scale electric power stations would allow the national grid to subsequently cut power to the smaller villages and towns allowing national assets to dump electrical power into its uranium enrichment. When, eventually the national assets would be needed elsewhere, locals focused their anger on local power stations, not at national figures. The Japan or the Korea Nitrogenous Fertilizer Company (朝鮮窒素肥料株式会社, *Chōsen Chisso Hiryō Kabushiki Kaisha*) (Nichitsu), Japan's largest *Konzern* located on the Korean Peninsula, headed by Noguchi Shitagau took the lead in developing the peninsula's national electric power system.

Noguchi Shitagau:
In 1926 Nichitsu established the Chosen Suiryoku Tenki Kabushiki Kaisha – the Korean Water Power Corporation – with a capital investment of 20 million yen to develop the hydroelectric power potential of the Pujon River. It was the largest capital investment scheme of its time in Korea, Japan's colonial market, the largest in East Asia.

Nichitsu's development of Korea's hydroelectric potential came as a result of decision to build a nitrogen fertilizer production facility at Konan (Hungnam) on the peninsula's east coast. As the nitrogen produced by Nichitsu would also be useful in the production of munitions, the Imperial Japanese Army and the Governors-General of Korea supported and approved the *Konzern's* decision. Further investment by Japan's major combines, zaibatsu and *Konzerns* followed. In 1930 Nichitsu's Chosen Chisso Hiryo Kaisha opened its first large-scale hydroelectric power station near Kanko (Hamhuing). By 1932 the total generating capacity of all powerplants on the peninsula had grown ten times the 1920 figure to 350,000 kilowatts. [26] It was Nichitsu's investment in the peninsula's electrical power industry in support of its fertilizer production that substantiated Korea's value as a location for heavy industries.

In 1932 the Governors-General established new rules governing the development and operation of any additional power stations on the peninsula; any future plants had to be approved by the Governors-General prior to construction. The government of Korea would now be responsible for the design of all future power stations. This follow-on enactment of specific laws by the Governors-General in Keijo (Seoul) secured Nichitsu's position as the "King of Electric Power" in Korea. The Governors-General would exercise management of all powerplants, to include the approval of senior managers and technical personnel assigned to the power stations by the companies involved. All power stations would remain the property of the various corporations involved, with the single exception of the Kenjiho (Songnim) plant which was a municipal power station, control and management of Korea's electrical power assets would, from this point forward, be heavily influenced by the Governors-General. [27] Similarly, the Japanese installed government of Pu Yi in Manchuria would underwrite the construction of power stations along the Yalu River sharing the costs with the Governors-General of Korea, and Nichitsu. This same system was later adopted by the North Korean government and would work to aid that country, as it did the Japanese in WWII, in the development of its later uranium enrichment program.

Following the new rules enacted by the Korea Governors-General, of the 63 electric power companies operating in Korea in 1933 the number dropped through mergers to only 18 in 1939. [28] The number of power companies operating in Korea eventually settled out at around 15. [29]

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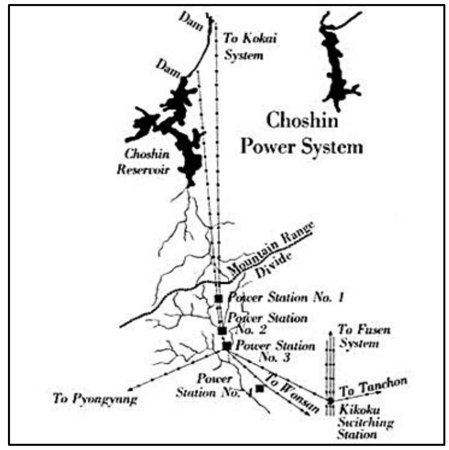
[24] Grajdanzev, Andrew J. Modern Korea. International Secretariat, Institute of Pacific Relations. The John Day Company. New York. 1944
[25] Grajdanzev, Andrew J. Modern Korea. International Secretariat, Institute of Pacific Relations. The John Day Company. New York. 1944
[26] Electric Power of Korea. Strategic Engineering Study. S.E.S.157. Engineer Research Office. North Atlantic Division. Corps of Engineers. Office, Chief of Engineers, US Army. February 1945. Record Group 331. Stack Area 290. Row 21. Compartment 22. Shelf 5. SCAP. General Subject File. 1943-1945. Box 8345. Folder – Korea 7. NND775019. The US National Archives and Records Administration, 8601 Adelphi Road, College Park, MD 20740-6001.
[27] Gusts of Popular Feeling. 29 January 2009. http://populargusts. blogspot. com/2009_01_01_archive. html
[28] Grajdanzev, Andrew J. Modern Korea. International Secretariat, Institute of Pacific Relations. The John Day Company. New York. 1944
[29] Korea, Parts I and II. Enemy Branch. Ministry of Economic Warfare. Copy Number 56. 8 December 1943. Record Group 226. Stack Area 190. Row 3. Compartment 28. Shelf 6. Entry 16. Box 853. File Number 70913. NND750140. The US National Archives and Records Administration, 8601 Adelphi Road, College Park, MD 20740-6001.

Japan’s later move into Manchuria, the subsequent creation of the state of Manchukuo and war with China further secured the peninsula’s importance as an industrial center supporting the Empire’s advance onto the Asian mainland. The peninsula’s nearness to Japan relative to Manchuria further increased its strategic importance to an expanding empire. The potential for producing additional electricity power from hydroelectric resources to support industrial plant encouraged the growth of Japanese industries along the country’s northeast coast. Korea slowly became a strategic asset in Japanese ambitions. Electrical power would break new ground for the Japanese and subsequently, North Korea.

By March 1938 the electrical power generating capacity of the peninsula stood at 668,100 kilowatts; hydroelectric powerplants accounted for 522,300 kilowatts of installed capacity. Another 848,500 kilowatts hydroelectric capacity was under construction. 798,300 kilowatts of this additional plant would be derived from hydroelectric power stations. [30] By 1940 the construction of additional hydroelectric plants would increase overall production by 710,000 kilowatts while thermal powerplant construction would increase by only another 40,000 kilowatts.



The largest of Korea’s powerplants in operation or under construction in 1940 were located along the Chosin (Changjin), Funei (Puryong), Fusen (Pujon), Kokai (Kanggye), Kyosen (Hoch’on), and Yalu Rivers. The dams, reservoirs, powerplants and turbine-generator sets installed in Korea were among the largest in the world. That same year, 1940, 67-year-old Noguchi Shitagau the founder of Nichitsu suffered an intracranial hemorrhage while visiting Seoul. In the aftermath of the hemorrhage Noguchi began to withdraw from public life and active direction of the company. It is likely that Noguchi himself was aware of the country’s wartime atomic weapons program but, probably only to the degree required to gain his support the program’s overall objectives. Noguchi would not live to see the subsequent efforts by Japanese military to adapt and assume management of Nichitsu’s various industries, to build an atomic weapon. North Korea’s Kim Il-sung would later succeed where the Japanese military failed.

By 1943 it was estimated that the overall generating capacity of all powerplants on the peninsula exceeded 2,000,000 kilowatts. [31] A February 1945 US Army Corps of Engineers Strategic Engineering Study estimated Korea’s 1943 installed capacity to be in excess of 2,500,000 kilowatts. [32] Another study projected that by 1945 the electrical power production capacity of the Korean Peninsula would exceed 3,000,000 kilowatts. [33] By comparison, the production capacity of 1937 Japan stood at about 7,000,000 kilowatts while the electrical power production capacity of the US stood at 42,000,000 kilowatts. In 1941 all powerplants located in Korea with the exception of those located along the Yalu River which would remain independent, were nationalized and brought under the direct supervision of the Korea Governors-General. [34] Subsequently, North Korea would never actually change the Japanese control system, but continue on the course developed by the Korean Governors-General.

While the Governors-General Korea encouraged the growth of Korea’s hydroelectric potential despite the vast amounts of brown and bituminous coal across the peninsula, the Japanese did little to expand the growth of the peninsula’s thermoelectric power generation capabilities. During Japan’s Occupation the Japanese constructed few large-scale thermoelectric power stations in Korea. Few if any of Korea’s thermoelectric powerplants burned diesel

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[30] Grajdanzev, Andrew J. Modern Korea. International Secretariat, Institute of Pacific Relations. The John Day Company. New York. 1944

[31] Grajdanzev, Andrew J. Modern Korea. International Secretariat, Institute of Pacific Relations. The John Day Company. New York. 1944

[32] Electric Power of Korea. Strategic Engineering Study. S.E.S.157. Engineer Research Office. North Atlantic Division. Corps of Engineers. Office, Chief of Engineers, US Army. February 1945. Record Group 331. Stack Area 290. Row 21. Compartment 22. Shelf 5. SCAP. General Subject File. 1943-1945. Box 8345. Folder – Korea 7. NND775019. The US National Archives and Records Administration, 8601 Adelphi Road, College Park, MD 20740-6001.

[33] Korea, Bombing Objectives. Enemy Branch, Foreign Office ad Ministry of Economic Warfare, Lansdowne House, Berkeley Square, London. W. 1. dated 14 July 1944. 111301. Record Group: Records of the OSS. Research and Analysis Branch Division. Intelligence Reports. Entry 16. Box 1258.

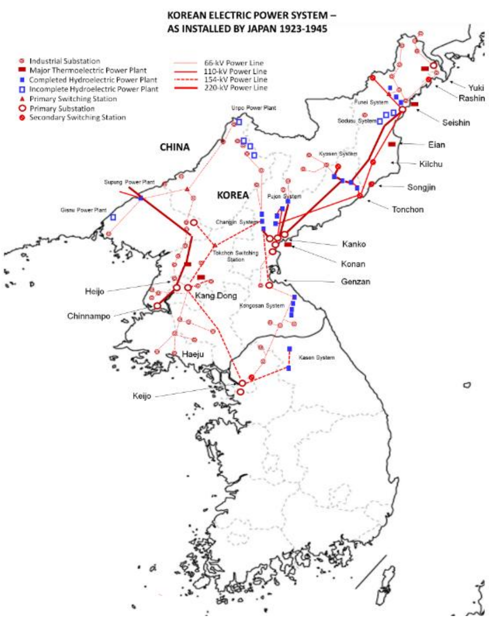
[34] Electric Power of Korea. Strategic Engineering Study. S.E.S.157. Engineer Research Office. North Atlantic Division. Corps of Engineers. Office, Chief of Engineers, US Army. February 1945. Record Group 331. Stack Area 290. Row 21. Compartment 22. Shelf 5. SCAP. General Subject File. 1943-1945. Box 8345. Folder – Korea 7. NND775019. The US National Archives and Records Administration, 8601 Adelphi Road, College Park, MD 20740-6001.

or fuel oils. There are actually no reports from WWII of diesel or fuel-oil medium-scale power stations operating in Korea.

The two largest thermoelectric plants discussed in wartime documents include a 100-megawatt plant located at Neietsu (Yongwol) in Kogen-do (Kangwon Province) and a 50-megawatt plant at Sanchoku (Samch'ok) in the same province. [35] Nichitsu's on-site powerplant; a Standley thermal plant was rated at 14,000 kilowatts. There were three 10-megawatt thermoelectric power stations in Korea, one each at; Seoul, Rysuzan (Yongsan) and Seishin (Chongjin). [36] The next largest thermoelectric power station, a nine-megawatt plant was located at Fusan (Pusan). One four-megawatt plant was located north of Yuki near the Korea-Russian border. All remaining thermoelectric power stations located on the peninsula were far smaller.

Japanese Hydroelectric Power Stations in Korea:
The Japanese installed national power system on the Korean Peninsula centered on six major hydroelectric power complexes each consisting of a number of large-scale hydroelectric power stations. The six complexes consisted of the Fusen (4 plants), Chosin (7 plants), Kyosen (4), Funei (2), Kokai (4) and Suiho (Supung) power systems. Most other thermoelectric and hydroelectric power stations on the peninsula provided dedicated support to a single customer only or some municipality. Though two of these dedicated power stations were rated as large-scale powerplants in excess of 20 megawatts (MW); most however, did not materially add to the power available across the peninsula's national-grid.

The Fusen Power System:
Construction on the Fusen system began in 1926. It was the first hydroelectric powerplant constructed by the Nichitsu *Konzern* in support of its industrial expansion onto the Korean Peninsula. Construction of the system was a direct result of cooperation between Nichitsu and the Governors-General of Korea.



The Fusen system contained four generating plants deriving their power from a series of three reservoirs located to the west of Puksubaek-san, a mountain in the Nangrim Range. The Fusen Reservoir was the largest of the three man-made lakes and was located at an elevation of 4,015 foot. The dam forming the Fusen Reservoir stood 285-foot-tall and 1312-foot-wide, providing a reservoir of nine square miles. [37] The maximum depth of the reservoir was 239 foot. The reservoir's shallows were 88 foot deep. The maximum capacity of the reservoir was calculated to be 23,660,826,703 cubic foot of water. 16,421,320,025 cubic foot of water was available to support power generation. 20,000 people per day for a period of three years are reported to have worked on the construction of the Fusen River Dam. The main dam required 150,000 tons of cement. The other two reservoirs supporting the system were located downstream of the main reservoir but were designed to serve as additional storage facilities in support of the main reservoir. All reservoirs constructed had a secondary purpose of providing water for irrigation, sometimes over large areas. Some pumped water long distances to meet area water and agricultural needs.

[35] Korea, Bombing Objectives. Enemy Branch, Foreign Office ad Ministry of Economic Warfare, Lansdowne House, Berkeley Square, London. W. 1. dated 14 July 1944. 111301. Record Group: Records of the OSS. Research and Analysis Branch Division. Intelligence Reports. Entry 16. Box 1258.
[36] Electric Power of Korea. Strategic Engineering Study. S.E.S.157. Engineer Research Office. North Atlantic Division. Corps of Engineers. Office, Chief of Engineers, US Army. February 1945. Record Group 331. Stack Area 290. Row 21. Compartment 22. Shelf 5. SCAP. General Subject File. 1943-1945. Box 8345. Folder – Korea 7. NND775019. The US National Archives and Records Administration, 8601 Adelphi Road, College Park, MD 20740-6001.
[37] Grajdanzev, Andrew J. Modern Korea. International Secretariat, Institute of Pacific Relations. The John Day Company. New York. 1944

During periods of low water levels in the primary reservoir water from the two lower lakes was pumped to the main reservoir from two separate pumping stations, one station located on each reservoir. [38] Five 2,500 horsepower pumps were used to transfer water 400 foot upward and into the main reservoir. [39] When in use, the pumps consumed the combined entire power generation capacity of the third and fourth powerplants downstream of the first generating station. [40] It was an expensive way to operate but a way that neither the Japanese atomic weapons program, nor the North Korean uranium enrichment program could avoid, when necessary.

Water from the primary reservoir was carried through the mountains separating the Pujon Plateau from the coastal plains by a concrete-lined headrace pressure tunnel 12.1-foot-wide, extending eastward 16.5 miles through the mountains. The headrace pressure tunnel created an operating head of 2,319 foot above the first powerplant in the system. [41] Water from the headrace tunnel entered a surge tank located above the first station. From the surge tank water dropped through four 9,280-foot-long penstocks. An extension of the aqueduct tunnel system, each pipe supported a single turbine-generator set located inside the generating plant. [42] Portions of the penstock system were located underground. Unlike the aqueduct, each penstock was either steel or steel lined. [43] The first plant in the Fusen System, Fusen-ko Hydroelectric Powerplant Number One had a rated production capacity of 130,000 kilowatts, three times the capacity of the largest hydroelectric power station then operating in Japan. [44] The stations supporting the system were impressive.

Fusen-ko Hydroelectric Powerplant Number One was built into solid bedrock. 15,695 cubic yards of rock was excavated from the construction site. [45] A nearly equal amount of concrete was poured to replace the rock removed. The plant's operating head was 2,296 foot. [46] Its four generators, built by Siemens of Germany, produced 36,000 kilovolt amps and each weighed in at 230 tons. [47] Before the end of WWII, one of the system's generators had been damaged and had not been repaired prior to the Korean War. [48] Each generator supported its own single-circuit 110,000 kilovolt high tension transmission line. [49] If necessary, all lines extending from the plant could be operated in parallel. [50] The plant's turbines, manufactured by S.M. Voith, operated at 360 revolutions per minute (rpm) and

[38] Stewart, James T. Airpower. The Decisive Force in Korea. D. Van Nostrand Company, Inc. New York. 1957.
[39] Stewart, James T. Airpower. The Decisive Force in Korea. D. Van Nostrand Company, Inc. New York. 1957.
[40] Stewart, James T. Airpower. The Decisive Force in Korea. D. Van Nostrand Company, Inc. New York. 1957.
[41] Grajdanzev, Andrew J. Modern Korea. International Secretariat, Institute of Pacific Relations. The John Day Company. New York. 1944
[42] Stewart, James T. Airpower. The Decisive Force in Korea. D. Van Nostrand Company, Inc. New York. 1957.
[43] Electric Power of Korea. Strategic Engineering Study. S.E.S.157. Engineer Research Office. North Atlantic Division. Corps of Engineers. Office, Chief of Engineers, US Army. February 1945. Record Group 331. Stack Area 290. Row 21. Compartment 22. Shelf 5. SCAP. General Subject File. 1943-1945. Box 8345. Folder – Korea 7. NND775019. The US National Archives and Records Administration, 8601 Adelphi Road, College Park, MD 20740-6001.
[44] Stewart, James T. Airpower. The Decisive Force in Korea. D. Van Nostrand Company, Inc. New York. 1957.
[45] Electric Power of Korea. Strategic Engineering Study. S.E.S.157. Engineer Research Office. North Atlantic Division. Corps of Engineers. Office, Chief of Engineers, US Army. February 1945. Record Group 331. Stack Area 290. Row 21. Compartment 22. Shelf 5. SCAP. General Subject File. 1943-1945. Box 8345. Folder – Korea 7. NND775019. The US National Archives and Records Administration, 8601 Adelphi Road, College Park, MD 20740-6001.
[46] Electric Power of Korea. Strategic Engineering Study. S.E.S.157. Engineer Research Office. North Atlantic Division. Corps of Engineers. Office, Chief of Engineers, US Army. February 1945. Record Group 331. Stack Area 290. Row 21. Compartment 22. Shelf 5. SCAP. General Subject File. 1943-1945. Box 8345. Folder – Korea 7. NND775019. The US National Archives and Records Administration, 8601 Adelphi Road, College Park, MD 20740-6001.
[47] Electric Power of Korea. Strategic Engineering Study. S.E.S.157. Engineer Research Office. North Atlantic Division. Corps of Engineers. Office, Chief of Engineers, US Army. February 1945. Record Group 331. Stack Area 290. Row 21. Compartment 22. Shelf 5. SCAP. General Subject File. 1943-1945. Box 8345. Folder – Korea 7. NND775019. The US National Archives and Records Administration, 8601 Adelphi Road, College Park, MD 20740-6001.
[48] The Electric Power Industry of North Korea. Provisional Intelligence Report. CIA/RR PR-148. (ORR Project 27.8789). Office of Research and Reports. Central Intelligence Agency. 21 September 1956
[49] Electric Power of Korea. Strategic Engineering Study. S.E.S.157. Engineer Research Office. North Atlantic Division. Corps of Engineers. Office, Chief of Engineers, US Army. February 1945. Record Group 331. Stack Area 290. Row 21. Compartment 22. Shelf 5. SCAP. General Subject File. 1943-1945. Box 8345. Folder – Korea 7. NND775019. The US National Archives and Records Administration, 8601 Adelphi Road, College Park, MD 20740-6001.
[50] Electric Power of Korea. Strategic Engineering Study. S.E.S.157. Engineer Research Office. North Atlantic Division. Corps of Engineers. Office, Chief of Engineers, US Army. February 1945. Record Group 331. Stack Area 290. Row 21. Compartment 22. Shelf 5. SCAP. General Subject File. 1943-1945. Box 8345. Folder – Korea 7. NND775019. The US National Archives and Records Administration, 8601 Adelphi Road, College Park, MD 20740-6001.

were rated at 45,000 horsepower. [51] Each turbine alone weighed 100 tons. [52] The maximum guaranteed efficiency of the turbines was 89 percent. [53] The plant's main transformers built by Tokyo Shibaura Electric, stepped up power from 11,000 volts to 110,000 volts. [54] Each transformer by itself weighed 98 tons. [55] The total capacity of the plant was 144,000 kilovolt amps. Initially the entire output of the plant was supplied directly to the Chosen Nitrogen Fertilizer Plant located 38 miles away. [56] As Nichitsu subsequently developed Korea's national electric power grid, the plant's substations were tied to that network. As Japan, and later North Korea began to expand their uranium enrichment programs, the electricity generated by this and other systems, could diverted away from their dedicated customers, and be fed into the ongoing processes located at Hungnam and later, Sinanju.

Hydraulically Linked:

Water exiting the first plant, the station's tailrace located 1,581 foot above mean sea level was led into a second concrete lined tunnel, 3.6 miles long leading to the second powerplant in the system. The water tunnel exiting the first plant formed an operating head of 708 foot for use by Plant Number Two. The water tunnel fed a second set of penstocks, each about 1,550-foot-long extending from a surge tank located above the power station. Each penstock supported a single turbine-generator set located inside the power station. [57] The plant's generators could be operated singly or in parallel. Each generator in the system operated at 11 kilovolts. The total design capacity of the nine installed generators stood at 230,000 kilowatts. [58] The plant's turbines rotating at 460 rpm produced 31,000 horsepower. [59] Each turbine had a guaranteed efficiency of 89 percent. The transformers supporting the second plant were rated at 23,000 kilovolt amp and were manufactured by the Fuji Electrical Machine Manufacturing Company of Japan. [60] Water

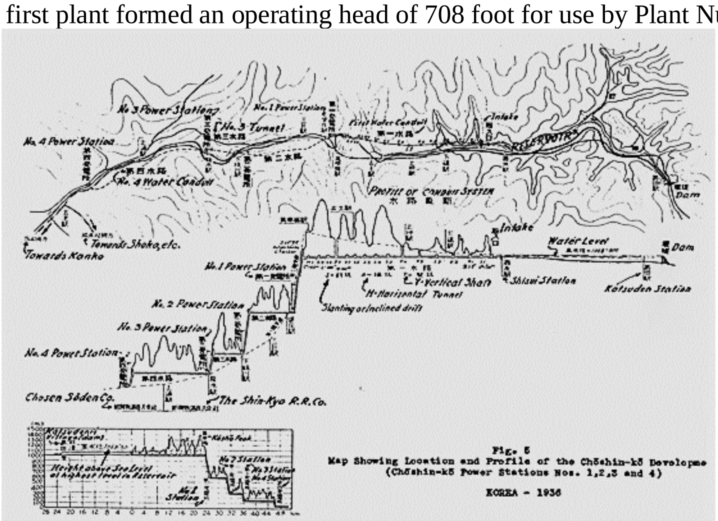


Fig. 5
Map Showing Location and Profile of the Chōshin-kō Developme
(Chōshin-kō Power Stations Nos. 1,2,3 and 4)
KOREA - 1936

[51] Electric Power of Korea. Strategic Engineering Study. S.E.S.157. Engineer Research Office. North Atlantic Division. Corps of Engineers. Office, Chief of Engineers, US Army. February 1945. Record Group 331. Stack Area 290. Row 21. Compartment 22. Shelf 5. SCAP. General Subject File. 1943-1945. Box 8345. Folder – Korea 7. NND775019. The US National Archives and Records Administration, 8601 Adelphi Road, College Park, MD 20740-6001.

[52] Electric Power of Korea. Strategic Engineering Study. S.E.S.157. Engineer Research Office. North Atlantic Division. Corps of Engineers. Office, Chief of Engineers, US Army. February 1945. Record Group 331. Stack Area 290. Row 21. Compartment 22. Shelf 5. SCAP. General Subject File. 1943-1945. Box 8345. Folder – Korea 7. NND775019. The US National Archives and Records Administration, 8601 Adelphi Road, College Park, MD 20740-6001.

[53] Electric Power of Korea. Strategic Engineering Study. S.E.S.157. Engineer Research Office. North Atlantic Division. Corps of Engineers. Office, Chief of Engineers, US Army. February 1945. Record Group 331. Stack Area 290. Row 21. Compartment 22. Shelf 5. SCAP. General Subject File. 1943-1945. Box 8345. Folder – Korea 7. NND775019. The US National Archives and Records Administration, 8601 Adelphi Road, College Park, MD 20740-6001.

[54] Electric Power of Korea. Strategic Engineering Study. S.E.S. 157. Engineer Research Office. North Atlantic Division. Corps of Engineers. Office, Chief of Engineers, US Army. February 1945. Record Group 331. Stack Area 290. Row 21. Compartment 22. Shelf 5. SCAP. General Subject File. 1943-1945. Box 8345. Folder – Korea 7. NND775019. The US National Archives and Records Administration, 8601 Adelphi Road, College Park, MD 20740-6001.

[55] Electric Power of Korea. Strategic Engineering Study. S.E.S. 157. Engineer Research Office. North Atlantic Division. Corps of Engineers. Office, Chief of Engineers, US Army. February 1945. Record Group 331. Stack Area 290. Row 21. Compartment 22. Shelf 5. SCAP. General Subject File. 1943-1945. Box 8345. Folder – Korea 7. NND775019. The US National Archives and Records Administration, 8601 Adelphi Road, College Park, MD 20740-6001.

[56] Electric Power of Korea. Strategic Engineering Study. S.E.S. 157. Engineer Research Office. North Atlantic Division. Corps of Engineers. Office, Chief of Engineers, US Army. February 1945. Record Group 331. Stack Area 290. Row 21. Compartment 22. Shelf 5. SCAP. General Subject File. 1943-1945. Box 8345. Folder – Korea 7. NND775019. The US National Archives and Records Administration, 8601 Adelphi Road, College Park, MD 20740-6001.

[57] Grajdanzev, Andrew J. Modern Korea. International Secretariat, Institute of Pacific Relations. The John Day Company. New York. 1944

[58] Stewart, James T. Airpower. The Decisive Force in Korea. D. Van Nostrand Company, Inc. New York. 1957.

[59] Electric Power of Korea. Strategic Engineering Study. S.E.S. 157. Engineer Research Office. North Atlantic Division. Corps of Engineers. Office, Chief of Engineers, US Army. February 1945. Record Group 331. Stack Area 290. Row 21. Compartment 22. Shelf 5. SCAP. General Subject File. 1943-1945. Box 8345. Folder – Korea 7. NND775019. The US National Archives and Records Administration, 8601 Adelphi Road, College Park, MD 20740-6001.

[60] Electric Power of Korea. Strategic Engineering Study. S.E.S. 157. Engineer Research Office. North Atlantic Division. Corps of Engineers. Office, Chief of Engineers, US Army. February 1945. Record Group 331. Stack Area 290. Row 21. Compartment 22. Shelf 5. SCAP. General

from the tailrace of the second powerplant entered a third aqueduct, 3.2 miles long which fed water into the third plant in the system.

The second, third and fourth generating plants were located three, seven and twelve miles downstream of the first power station. [61] The operating heads of the third and fourth power stations were 308 and 134 foot respectively. [62] Water discharged from the fourth and final power station exited into the Songchong River, near Shinko (Sinhung) west of Hungnam. [63] In November 1929 the first portion of the Fusen River Dam was completed, providing a generating capacity of 65,000 kilowatts. [64] The Chosen Chisso fertilizer plant began operations only two months later, in January 1930. The broader Fusen hydroelectric powerplant system was completed in 1932.

38 miles separated the first plant in the Fusen system from the last. Power produced at each plant was stepped up to 110 kilovolts for transmission to industries supported by the grid extending outward from the generating complex. Two sets of double-circuit high-tension 110-kV power lines extended between the first, second and third powerplants in the system. At least one set of lines extended from the system directly to the Nichitsu chemical plant located at Hungnam, other lines would later connect the four plants to what would eventually become the peninsula's national grid. High-tension power lines would later connect the Fusen-ko development to the Chosin power system. In the ten years after the construction of the Pujon River powerplant system, the Nichitsu-Ugaki partnership succeeded in developing most of the peninsula's hydroelectric potential. [65] Any potential sites that were not otherwise fully developed in that ten-year period were under construction. Some were under construction during and completed during the war.

The Chosin System:
In time Nichitsu also developed the hydroelectric power resources of the Changjin River, creating, once again, a hydroelectric cascade that harnessed the river's power for industries located in and around Hungnam. For this project the Japanese forced a northward flowing river to flow southward into a new set of underground aqueducts feeding another series of power station, another cascade, located on the east face of the Jangbaik Mountains. The cascade's reservoir was created by a series of four dams along the Changjin River. Chosin being the Japanese name for the power system and its reservoir. [66] In 1950, during the Korean War, the area of the reservoir was the scene of a series of unusually brutal engagements between Chinese Peoples Volunteer Forces and forces of the US in what became known as the Battles of the Chosin Reservoir.

The Chosin System was the second major hydro-electric power scheme constructed in Korea. [67] The power system was constructed in the 1930s to meet the demand for additional power by the functional areas of Nichitsu plants either operating at Hungnam or under construction.

Though constructed just a few years after the completion of the Fusen system, the Chosin's turbine-generator sets and so on were far more modern, up-to-date and efficient than those of the Fusen cascade. Two reservoirs supported the power system.

The larger of the two reservoirs, the Chosin-ho, was formed by a concrete dam 159 foot in height, 2,404 foot in length. The reservoir created by the dam held 37,398,232,058 cubic foot of water. [68] The effective volume available to the system's generators stood at 29,664,320,046 cubic foot. [69] Two separate concrete-lined aqueducts one each,

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Subject File. 1943-1945. Box 8345. Folder – Korea 7. NND775019. The US National Archives and Records Administration, 8601 Adelphi Road, College Park, MD 20740-6001.

[61] Stewart, James T. Airpower. The Decisive Force in Korea. D. Van Nostrand Company, Inc. New York. 1957.

[62] Grajdanzev, Andrew J. Modern Korea. International Secretariat, Institute of Pacific Relations. The John Day Company. New York. 1944

[63] Stewart, James T. Airpower. The Decisive Force in Korea. D. Van Nostrand Company, Inc. New York. 1957.

[64] Stewart, James T. Airpower. The Decisive Force in Korea. D. Van Nostrand Company, Inc. New York. 1957.

[65] Stewart, James T. Airpower. The Decisive Force in Korea. D. Van Nostrand Company, Inc. New York. 1957.

[66] Strategic Engineering Study, S.E.S. 157, Electric Power of Korea. Prepared by the Engineer Research Office, North Atlantic Division, Corps of Engineers. Strategic Intelligence Branch, Military Intelligence Division Office, Chief of Engineers. US Army. February 1945. NND775019. The US National Archives and Records Administration, 8601 Adelphi Road, College Park, MD 20740-6001

[67] Electric Power of Korea. Strategic Engineering Study. S.E.S. 157. Engineer Research Office. North Atlantic Division. Corps of Engineers. Office, Chief of Engineers, US Army. February 1945. Record Group 331. Stack Area 290. Row 21. Compartment 22. Shelf 5. SCAP. General Subject File. 1943-1945. Box 8345. Folder – Korea 7. NND775019. The US National Archives and Records Administration, 8601 Adelphi Road, College Park, MD 20740-6001.

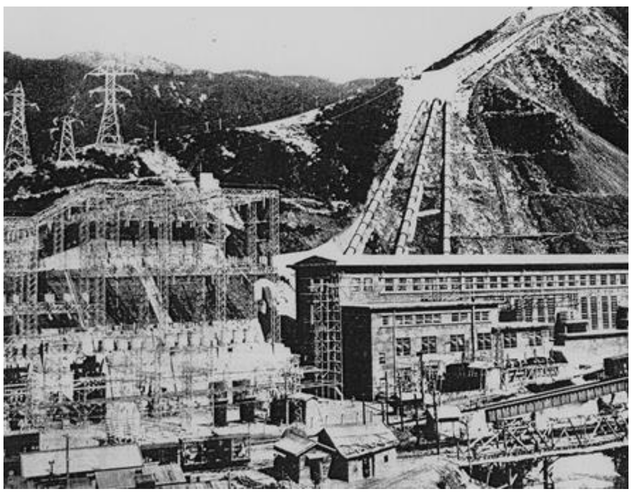
[68] Grajdanzev, Andrew J. Modern Korea. International Secretariat, Institute of Pacific Relations. The John Day Company. New York. 1944

[69] Grajdanzev, Andrew J. Modern Korea. International Secretariat, Institute of Pacific Relations. The John Day Company. New York. 1944

extended from each reservoir to a surge tank above the first powerplant in the system. [70] The Chosin system consisted of a total of seven separate powerplants; four large-scale, and three medium-scale plant with a total design capacity of over 300,000 kilowatts. [71]

Plant number One, Chosin Number 1, of the Chosin system was designed to produce 144,000 kilowatts. [72] Water was fed to the plant from the two concrete-lined aqueducts originating at the two reservoirs to a surge tank located above the generating station and then into four alternating, five and six-foot wide penstocks. [73] The plant's four penstocks measured 5,418-foot-long. [74] The penstocks created an operating head of 1,525 foot. [75] The powerplant itself contained four horizontally mounted 60-cycle turbine-generator sets each producing 10,500 kilovolts. [76] Each turbine was rated at 36,000 kilowatts each. The transformer substation and switchyard serving the plant were located next to the main generating hall. As with the Fusen system water exiting the first powerplant, the plant's tailrace, was fed into a second set of concrete-lined aqueducts that fed the next plant in the system, Chosin Number 2.

Chosin Number 2 was located four miles downstream from the first powerplant in the system and was completed in January 1937. [77] The second plant contained four vertical generators rated at 31,111 kilovolt amps each. [78] Penstocks dropping water to the plant created an operating head of 1,027 foot. [79] The power station's total design capacity was between 106,000 and 112,000 kilowatts. [80] The plant's transformer substation and switch yard were located immediately adjacent to the power station. The tailrace of Chosin Number 2 was fed again, into a third concrete-lined aqueduct to generate additional power at Chosin Number 3.



Plant Number Three was located 2.5 miles downstream of Chosin Number Two. Three penstocks fed water into the plant generating additional power from three vertical 15,500 kilovolt amp turbine-generator sets. [81] The operating head of plant three was 466 foot. [82] As with Chosin Number Two, water from the tailrace of the third plant was fed into a fourth concrete-lined aqueduct which fed water to Chosin Number Four. The fourth powerplant contained three smaller turbine-generator sets. Chosin Number Four was rated at 34,200 kilowatts possessing an operating head of 302 foot. [83] The system's three medium-scale power stations were located on the Plains of Hamhung west of the city, generating power from a canal leading from Chosin Number Four to a point near the coast. The power produced by the Chosin system was transmitted by the Korea Power Transmission Company to Pyongyang and Seoul on the west coast of the peninsula, Hungnam and Chongjin on the Korea's east coast. [84] The Kyosen power system was the last of the peninsula's major hydraulically interconnected power stations to be installed by the Japanese during their Occupation of Korea.

[70] Stewart, James T. Airpower. The Decisive Force in Korea. D. Van Nostrand Company, Inc. New York. 1957.
[71] Grajdanzev, Andrew J. Modern Korea. International Secretariat, Institute of Pacific Relations. The John Day Company. New York. 1944
[72] Stewart, James T. Airpower. The Decisive Force in Korea. D. Van Nostrand Company, Inc. New York. 1957.
[73] Stewart, James T. Airpower. The Decisive Force in Korea. D. Van Nostrand Company, Inc. New York. 1957.
[74] Stewart, James T. Airpower. The Decisive Force in Korea. D. Van Nostrand Company, Inc. New York. 1957.
[75] Grajdanzev, Andrew J. Modern Korea. International Secretariat, Institute of Pacific Relations. The John Day Company. New York. 1944
[76] Stewart, James T. Airpower. The Decisive Force in Korea. D. Van Nostrand Company, Inc. New York. 1957.
[77] Electric Power of Korea. Strategic Engineering Study. S.E.S. 157. Engineer Research Office. North Atlantic Division. Corps of Engineers. Office, Chief of Engineers, US Army. February 1945. Record Group 331. Stack Area 290. Row 21. Compartment 22. Shelf 5. SCAP. General Subject File. 1943-1945. Box 8345. Folder – Korea 7. NND775019. The US National Archives and Records Administration, 8601 Adelphi Road, College Park, MD 20740-6001.
[78] Stewart, James T. Airpower. The Decisive Force in Korea. D. Van Nostrand Company, Inc. New York. 1957.
[79] Grajdanzev, Andrew J. Modern Korea. International Secretariat, Institute of Pacific Relations. The John Day Company. New York. 1944
[80] Stewart, James T. Airpower. The Decisive Force in Korea. D. Van Nostrand Company, Inc. New York. 1957.
[81] Stewart, James T. Airpower. The Decisive Force in Korea. D. Van Nostrand Company, Inc. New York. 1957.
[82] Grajdanzev, Andrew J. Modern Korea. International Secretariat, Institute of Pacific Relations. The John Day Company. New York. 1944
[83] Stewart, James T. Airpower. The Decisive Force in Korea. D. Van Nostrand Company, Inc. New York. 1957
[84] Korea, Parts I and II. Enemy Branch. Ministry of Economic Warfare. Copy Number 56. 8 December 1943. Record Group 226. Stack Area 190. Row 3. Compartment 28. Shelf 6. Entry 16. Box 853. File Number 70913. NND750140. The US National Archives and Records Administration, 8601 Adelphi Road, College Park, MD 20740-6001.

The Kyosen System:
Work on the Kyosen System began while the Chosin system was still under construction. Four reservoirs were built to support the production of electrical power. [85] Stair-stepped through the mountains, the water of each reservoir could be used at any time to support power generation.

Due to the larger volume of water and the greater head pressures available to support the Kyosen system as compared to that of the Chosin and Fusen designs, the supporting water tunnels and penstocks of the Kyosen system were larger than others installed by the Japanese on the peninsula. [86] As with the other systems the water from the first plant was fed into additional tunnels to support the next plant in the system. Four power stations worked to extract energy from the moving water.

Each power station held four generators for a total of 16 turbine-generators sets operating throughout the system, each producing 11,000 volts at 60 cycles. [87] Total design capacity of the Fusen System stood at 394,000 kilowatts. [88] Nine to 11 miles separated one plant from the other. Two final interconnected systems the Funei and Kokai completed the Japanese development of cascade systems on the Korean Peninsula.

The Funei system was completed in 1939 and primarily supported the Japanese industries located in and around Chongjin.

The Kokai System:
The Kokai hydroelectric system in the Kanggye is reported as the most nearly complete of the considerable number of installations originally planned by the Japanese. The two power stations of the Kokai system completed before the end of WWII generated about 200,000 kilowatts. Work on the Kokai system would continue throughout much of the Korean War. [89] Oddly enough, the majority of the work completing Japan's Showa Shu Ri Kumiai underground facilities and water works were also completed during the Korean War. [90] To generate additional power the Japanese turned to run-of-river and base-of-dam powerplants: The largest of these were located on the Yalu River that formed the border separating Korea from Manchuria.

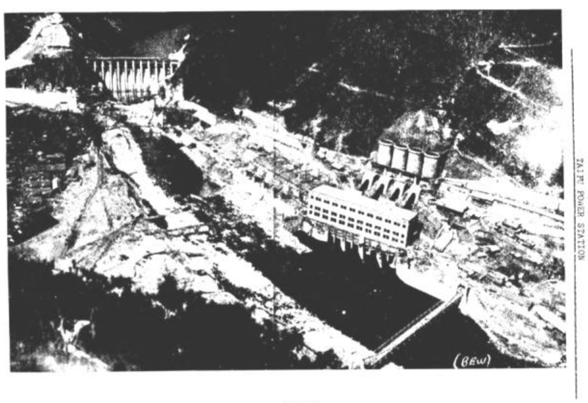


Fig. 40
Air View of the Taifu Power Station
Showing the Dam, the Surge Tanks, Penstocks and Power Plant

Supung/Suiho HPP:
In 1937, during Japan's colonization of Korea, the Yalu River Hydroelectric Company was established and construction began on the Supung Dam. In a sense, the company still exists today as the China – Korea Yalu River Hydroelectric Company. Due to the dam's massive requirements for cement and the heavy equipment that would be installed in its adjacent power station, the Pyeongbuk Railway opened a rail line to the dam's base in 1939. [91] 50 percent of the power generated by the plant would go north into Manchukuo, while the other 50 percent would go south to support industrial operations in Korea. At the time of its completion, the dam was the largest in Asia and second largest in the world. Power from the dam was used throughout the Korean peninsula and southern Manchuria (Manchukuo at the time). [92, 93]

[85] Stewart, James T. Airpower. The Decisive Force in Korea. D. Van Nostrand Company, Inc. New York. 1957
[86] Stewart, James T. Airpower. The Decisive Force in Korea. D. Van Nostrand Company, Inc. New York. 1957
[87] Stewart, James T. Airpower. The Decisive Force in Korea. D. Van Nostrand Company, Inc. New York. 1957
[88] Stewart, James T. Airpower. The Decisive Force in Korea. D. Van Nostrand Company, Inc. New York. 1957
[89] Daily Korean Bulletin. Central Intelligence Agency. Office of Current Intelligence. 12 July 1952. Approved For release 2004/09/03: CIA-RDP91T01172R000200110001-8
[90] Irrigation Works, Pyongan Namdo. KMAG (Korea Military Advisory Group) Liaison Office. 4302. 0300. North Korea. TB 2582 4671. T. I, G-2, Headquarters, Far East Command. Confidential Informant. 10 December 1949. Bibliographic ID (link to National Diet Library Online) digidepo_3540683 pdf-Anju
[91] 朝鮮總督府官報 (The Public Journal of the Governor-General of Korea), Shōwa Nr. 3813, 3 October 1939
[92] Rees, David (2001). Korea: An Illustrated History from Ancient Times to 1945. Hippocrene Books. Supung Dam Yalu 1937.
[93] Armstrong, K. Charles; Samuel S. Kim; Stephen Kotkin. Korea at the Center: Dynamics of Regionalism in Northeast Asia. M. E. Sharpe. 2005

The original power station at the base of the dam was planned to hold seven 105 MW Francis turbine-generators which were afforded an average hydraulic head of 77 m (253 ft). The additional power station on China's side contains two 67. 5 MW Francis turbine generators. The total installed capacity of the dam's power stations was 765 MW. [94]

The Supung/Suiho (Chinese: Shuifeng-tung, Korean: Supung) Hydroelectric Powerplant was located about 30 miles northeast of Antung, Manchuria along the Yalu River. It was the first of seven major powerplants that the Japanese designed for eventual installation on the Yalu River. [95] The Supung was the largest of these. Additional plants similar to the Supung HPP were to be built along the Yalu River at Gishu, Igen, Jigi, Kogen, Rinki and Shuan. The Japanese had also planned the construction of a similar such power station near Tokusen (Toch'on) in central northern Korea. It was probably in underground facilities near the Supung power station that Japan first undertook its first tests on its uranium enrichment processes. At least one of these plants located at Taifu was largely complete and operational by the end of the war, though most of the planned construction projects outside the Supung were incomplete or only in the design stage at the end of WWII. North Korea, needing to offset the drain of electrical power into their uranium enrichment program, would eventually move to complete some of these projects in the early part of the 2000s but, the country would never reach the apex of electrical power production planned by the Japanese.

50 Percent of the funds required to build the Supung powerplant were provided by the Manchurian Industrial Development Company through the Manchurian Yalu Water Power Company. The Korean Yalu Water Power Company provided an additional 40 percent of the investment required while Nichitsu provided the remainder. [96] The dam was constructed by the Japanese between 1937 and 1941. Final work on the dam was completed ended in 1943.

The Supung Dam measured 2,950-foot-long and stood 349 foot tall. [97] The dam was 262-foot-wide at its base, 26-foot-wide at its crest. [98] The dam was constructed by the Japanese between 1937 and 1943 in order to generate electricity and has been repaired and renovated several times throughout the years, mainly due to spillway damage from flooding but was also damaged during the Korean War.

The dam's power station and transformer yard were targeted by the United Nations Command three times during the Korean War in order to disrupt power supply. Between 23 and 24 June 1952, the dam was attacked by 250 bombers and fighters, dropping 90 tons of munitions on the power station, transformer yard and auxiliary facilities. The power station was destroyed but the dam was left intact. After intelligence indicated it may have been partially operational again, the power station was again targeted and disabled on 12 September 1952 by B-29 bombers. By 1 February 1953, it was believed that two generators had been repaired and were operational once again. This resulted in a third raid on the dam on 15 February which left the power station inoperable once again. [99]

Originally scheduled for completion in 1941 frequent heavy floods delayed its completion until just prior to the end of WWII. When completed it was the largest single powerplant in Asia and the fourth largest dam in the world after the Grand Coulee, Shasta and the Hoover Dams located in the US. Portions of the power station however, actually came on-line in 1943.

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[94] "Supung station (before restoration) Details" (in Chinese). Sino Hydro. 27 August 2011
[95] Grajdanzev, Andrew J. Modern Korea. International Secretariat, Institute of Pacific Relations. The John Day Company. New York. 1944
[96] Grajdanzev, Andrew J. Modern Korea. International Secretariat, Institute of Pacific Relations. The John Day Company. New York. 1944
[97] Stewart, James T. Airpower. The Decisive Force in Korea. D. Van Nostrand Company, Inc. New York. 1957.
[98] Grajdanzev, Andrew J. Modern Korea. International Secretariat, Institute of Pacific Relations. The John Day Company. New York. 1944
[99] Stewart, James T. Editor. Airpower. New York: Arno Press. 1980

Unlike the other plants built by the Japanese, the Suiho did not rely upon high water pressures created by lengthy aqueducts to generate electrical power but on the massive volume of water held back by the plant's dam. The reservoir created by the Suiho Dam covers an area of 128 square miles and is reported by various sources to stretch 60 miles up the Yalu River. The reservoirs surface area covers an expanse of 274 km^2 (106 sq. mi).[100] The dam's reservoir has a capacity of 14,600,000,000 m^3 (11,836,413-acre ft) of which 7,900,000,000 m^3 (6,404,634-acre ft) is active (or "useful") for power generation. The dam's spillway contains 26 sluice gates with a maximum discharge capacity of 37,650 m^3/s (1,329,597 cu ft/s). An auxiliary spillway 1.7 km (1 mi) north of the dam consists of 16 sluice gates and has a maximum discharge capacity of 17,046 m^3/s (601,974 cu ft/s). The powerplant itself was located at the base of the concrete Suiho Dam on the southern side of the Yalu River.

The design capacity of the plant was 700,000 kilowatts. [101] The plant's seven turbine-generator sets, rated at 143,000 horsepower each, were the most powerful in the world at that time. Daily operational capacity at maximum water levels was 640,000 kilowatts. Average water levels in the reservoir produced 445,000 kilowatts. At least one of the Supung's installed turbine-generator sets was built in Germany by Siemens-Schuckert just before the start of WWII. [102] Two of the plant's 100,000 kVA generators had been ordered from the same German company. [103] WWII prevented the second generator from being delivered. The plant's remaining five generators were built by Tokyo Shibaura Electric of Japan. [104] The plant's seven vertical Francis turbines were manufactured by Dengyosha of Japan. [105] Between four and six of the plant's 16,500-volt generators were installed before the end of WWII. Each turbine-generator set had an operating capacity of 100,000 kilowatts. Two of the plant's generators, numbers six and seven, produced only 60-cycle power for use in the Korean grid, while number's four and five generators provided power at 50-cycles for use in Manchukuo. [106] The lines extending from the plant into Manchukuo extended down the coast to Darien and the other inland to An-shan. [107] Two of its 100 MW generators became operational in 1941. The Emperor of Manchukuo, Pu Yi visited the site to mark the occasions. [108] Four generators were operational by 1943. At least four of the plant's turbine-generator sets were operational at the end of WWII. The Supung dam and power station were the last of the country's major completed by Japan before its surrender in August 1945.

Most of the electricity generated by the Supung hydroelectric powerplant (HPP) for the Korean grid supported the industries and population of Korea located on the western side of the peninsula at Pyongyang and Seoul, though the Korean national grid could move power anywhere around the peninsula. [109] The remaining power produced by the Supung HPP was transmitted into Manchuria in support of the Japanese installed heavy industries in Mukden, Harbin and as far away as Darien. The great loss of North Korean generating capacity in the years following WWII was partly a result of the removal of equipment by the Japanese and Soviets at the end of the war. [110] About 100 megawatts of the total generating capacity installed across the entire Korean Peninsula was destroyed by the departing Japanese in 1945. [111] In 1947 the Soviet Union seeking war reparations removed the Supung's third, fourth, and fifth turbines from the power station into Soviet Russia. [112] The Soviet Union later returned the removed generators to the Yalu River and reinstalled them in the Suiho plant during the 1950s. It is likely that the USSR counted the returned generators as, foreign aid. Those three were not present during the Korean War and remained, other than in Soviet hands, undamaged.

Manipulating Assets:

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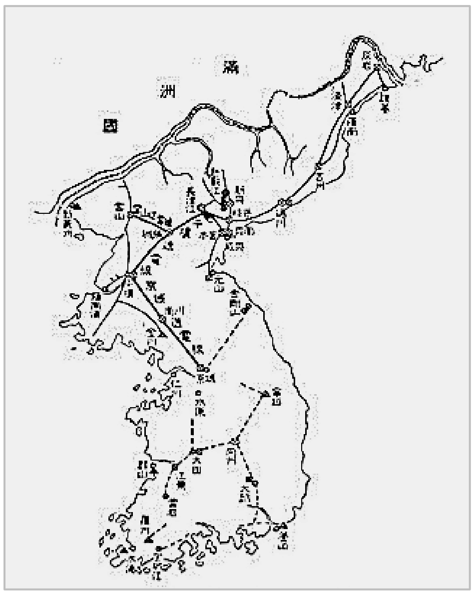
[100] Stewart, James T. Airpower. The Decisive Force in Korea. D. Van Nostrand Company, Inc. New York. 1957.
[101] Stewart, James T. Airpower. The Decisive Force in Korea. D. Van Nostrand Company, Inc. New York. 1957.
[102] Stewart, James T. Airpower. The Decisive Force in Korea. D. Van Nostrand Company, Inc. New York. 1957.
[103] Shimpo, Hirohiko. Overseas Business Activities of Japanese Companies in the Prewar Period: The Japanese Style Foreign Investment in the Prewar Period. Osaka Sangyo, University, Japan. The twelfth annual conference of the European Business History Association. 23 August 2008.
[104] Stewart, James T. Airpower. The Decisive Force in Korea. D. Van Nostrand Company, Inc. New York. 1957.
[105] Stewart, James T. Airpower. The Decisive Force in Korea. D. Van Nostrand Company, Inc. New York. 1957.
[106] Stewart, James T. Airpower. The Decisive Force in Korea. D. Van Nostrand Company, Inc. New York. 1957.
[107] The Electric Power Industry of North Korea. Provisional Intelligence Report. CIA/RR PR-148. (ORR Project 27.8789). Office of Research and Reports. Central Intelligence Agency. 21 September 1956
[108] Rees, David. Korea: An Illustrated History from Ancient Times to 1945. Hippocrene Books. Supung Dam Yalu 1937. 2001
[109] Stewart, James T. Airpower. The Decisive Force in Korea. D. Van Nostrand Company, Inc. New York. 1957.
[110] The Electric Power Industry of North Korea. Provisional Intelligence Report. CIA/RR PR-148. (ORR Project 27.8789). Office of Research and Reports. Central Intelligence Agency. 21 September 1956
[111] Provisional Intelligence Report. The Electric Power Industry of North Korea. CIA/RR PR-148. Office of Research and Reports. 21 September 1956.
[112] Stewart, James T. Airpower. The Decisive Force in Korea. D. Van Nostrand Company, Inc. New York. 1957.

The management of Korea's electrical power assets grew in importance as the industrial concerns began to install production facilities outward from Korea's northeast coast into the peninsula's major population centers however, the completion of the Supung power station represented excess capacity in Korea at the time its first generators came online. Once nationalized the powerplants operating on the peninsula were now also responsible for supplying power to the country's major cities. High tension 110-, 154-, and 220-kV power lines were constructed from the Yalu River to move power from the isolated plants located in the mountains into areas of national importance. It was these lines that would have powered the installation at Sinanju under the Japanese had it been completed in 1946, and would eventually indeed power the Sinanju facility when completed by North Korea in the 1970s. Yes, the 1970s.

The majority of the major powerplants installed on the peninsula were eventually connected to the national transmission grid, also built by Nichitsu, that enabled the bulk power being generated at geographically isolated powerplants in the northeastern mountains, to be transferred to the population centers and industries located across the country. The Japanese power system installed across the Korean Peninsula transmitted power along 110-, 154- and 220-kV power lines. The basic requirement for a uranium enrichment process is that the supporting electrical power grid must be sustained by a reliable; 1) single large-scale powerplant or 2) series of, major or minor powerplants, thermal or hydroelectric. This would have included the Sinanju Munitions Plant. Certain plants though connected to national grid such as the Kenjiho plant as we have seen however, were initially designed to support specific areas of the country or the industries located in their geographical areas only. [113]



Such plants, known as "dedicated powerplants" operated continuously in support of some specific industry or area, only drawing power from the national grid during periods of plant maintenance, shortages of coal, drought, or periods of excess demand. In the absence of power from the national grid such plants could disconnect from the network to operate independently as "islands," isolated pockets of electrical power that could operate independently when necessary. These plants rarely relied upon the country's national grid – the grid actually relied upon them. Though on a larger scale, this same concept would later be used by North Korea to energize and operate the country's uranium enrichment processes at Sinanju. The concept itself may have been developed initially by the Japanese to support this facility when it was planned in 1939 and only acted upon by Pyongyang later.

The Express Lane of Electrical Power

The Korea Power Transmission Company was established by Noguchi interests solely for the purpose of constructing and operating the transmission system that moved power from the Chosin system to the peninsula's largest cities of Heijo (Pyongyang) and Seoul. [114]

During WWII, intelligence analysts wrote that the Korean transmission system was under the direct control of the Governors-General. In return for establishing the country's grid the Korea Power Transmission Company received the rights to develop the power of the Kosuiin River, ultimately building several reservoirs near Hwangsuwon. [115] Electricity is generally transmitted at high voltages, 110-kV or higher normally through overhead power lines to reduce the energy lost in long-distance transmission.

The country's first transmission system, its 110-kV grid was installed along Korea's eastern and northeastern coasts to and north of Hungnam. This early national-level grid served to transmit the bulk power generated by the peninsula's large-scale hydroelectric powerplants located in isolated areas across the country, to national-level

[113] Stewart, James T. Airpower. The Decisive Force in Korea. D. Van Nostrand Company, Inc. New York. 1957.
[114] Korea, Parts I and II. Enemy Branch. Ministry of Economic Warfare. Copy Number 56. 8 December 1943. Record Group 226. Stack Area 190. Row 3. Compartment 28. Shelf 6. Entry 16. Box 853. File Number 70913. NND750140. The US National Archives and Records Administration, 8601 Adelphi Road, College Park, MD 20740-6001.
[115] *Ibid.*

transformer substations located along the grid. These national-level substations would then step the power down to distribution-level voltages for use in its specific geographic area. Over 134 miles of 110,000-volt lines was in-place by March 1931. [116] By March 1938 the 110-kV system had grown to distance of 408 miles. [117] It was by design a regional grid only. It was this grid, that initially supported the majority of Japan's atomic infrastructure on the peninsula's east coasts; at Chongjin, Hamhung, Hungnam and Wonsan. The Japanese eventually installed additional and higher-voltage transmission systems across the peninsula.

A higher-level transmission system consisting of 154-kV power transmission lines were installed between 1931 and 1938. These higher kilovolt lines allowed greater amounts of bulk power to be shipped from their production centers in the high mountains eastward to the centers of demand located along Korea's east coast. By 1939 the 154-kV system covered a distance of 423 miles. [118] The 154-kV system nearly paralleled the 110-kV system, but also transmitted power cross country to a national-level substation east of Pyongyang where power was further transmitted to Seoul and other population centers along the west coast of the country. The final high-voltage system installed by the Japanese; a 220-kV transmission system was far more extensive that the 110-kV regional grid.

The 220-kilovolt transmission system was installed after 1939 and was far more extensive than the previous 110- and 154-kV transmission grids. Like its lower-voltage predecessors the 220-kV system moved bulk power from the large powerplants then operating, or as constructed, along the Yalu River and its tributaries to Chinamp'o (Nampo), Pyongyang, Seoul, and as far south as Pusan. By 1945 the 220-kV system would measure 2,025 miles in length, twice the length of the country's 110- and 154-kV systems combined and stretched the entire length of the peninsula. Unlike the 110- and 154-kV grids, the 220-kV grid served the entire country, east and west coasts. [119] No further expansion of these two systems occurred under the Japanese during the remainder of the occupation. [120]

The national grid installed across Korea by the Japanese before the end of the war operated at three kilovolt ranges, 110-, 154- and 220-kV. All three of these transmission systems extended into the area of Hungnam. These still exist in modern-day North Korea. Power was transmitted along single-, double-, and triple-circuit lines. Most power stations were connected to the national grid for power transmission purposes but also plant-to-plant for operational purposes. Though the nation's power system was interconnected, transmitting power throughout the country, the mountainous interior of the country forced the national grid to be operated nearly as two separate grids; [121] an eastern grid along the narrow coastal plains abutting the East Sea and a western grid located on the Plains of Pyongyang. The only 220-kV connection between the two sides of the electrical system ran between Hamhung, Puk'chang and then Pyongyang. A 66-kV line crossed North Korea from the Chosin cascade north to the Tongogang Power Station, completed around 1959, and then to the grid supporting the Supung hydroelectric power station. [122]The eastern grid drawing its power from hydroelectric power stations located high in Korea's mountains primarily supported the Japanese industries located at Genzan (Wonsan), Hungnam, Raman (Nanam), Chongjin, and so on. **[123]**

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[116] Electric Power of Korea. Strategic Engineering Study. S.E.S. 157. Engineer Research Office. North Atlantic Division. Corps of Engineers. Office, Chief of Engineers, US Army. February 1945. Record Group 331. Stack Area 290. Row 21. Compartment 22. Shelf 5. SCAP. General Subject File. 1943-1945. Box 8345. Folder – Korea 7. NND775019. The US National Archives and Records Administration, 8601 Adelphi Road, College Park, MD 20740-6001.

[117] Electric Power of Korea. Strategic Engineering Study. S.E.S. 157. Engineer Research Office. North Atlantic Division. Corps of Engineers. Office, Chief of Engineers, US Army. February 1945. Record Group 331. Stack Area 290. Row 21. Compartment 22. Shelf 5. SCAP. General Subject File. 1943-1945. Box 8345. Folder – Korea 7. NND775019. The US National Archives and Records Administration, 8601 Adelphi Road, College Park, MD 20740-6001.

[118] Electric Power of Korea. Strategic Engineering Study. S.E.S. 157. Engineer Research Office. North Atlantic Division. Corps of Engineers. Office, Chief of Engineers, US Army. February 1945. Record Group 331. Stack Area 290. Row 21. Compartment 22. Shelf 5. SCAP. General Subject File. 1943-1945. Box 8345. Folder – Korea 7. NND775019. The US National Archives and Records Administration, 8601 Adelphi Road, College Park, MD 20740-6001.

[119] Electric Power of Korea. Strategic Engineering Study. S.E.S. 157. Engineer Research Office. North Atlantic Division. Corps of Engineers. Office, Chief of Engineers, US Army. February 1945. Record Group 331. Stack Area 290. Row 21. Compartment 22. Shelf 5. SCAP. General Subject File. 1943-1945. Box 8345. Folder – Korea 7. NND775019. The US National Archives and Records Administration, 8601 Adelphi Road, College Park, MD 20740-6001.

[120] Electric Power of Korea. Strategic Engineering Study. S.E.S. 157. Engineer Research Office. North Atlantic Division. Corps of Engineers. Office, Chief of Engineers, US Army. February 1945. Record Group 331. Stack Area 290. Row 21. Compartment 22. Shelf 5. SCAP. General Subject File. 1943-1945. Box 8345. Folder – Korea 7. NND775019. The US National Archives and Records Administration, 8601 Adelphi Road, College Park, MD 20740-6001.

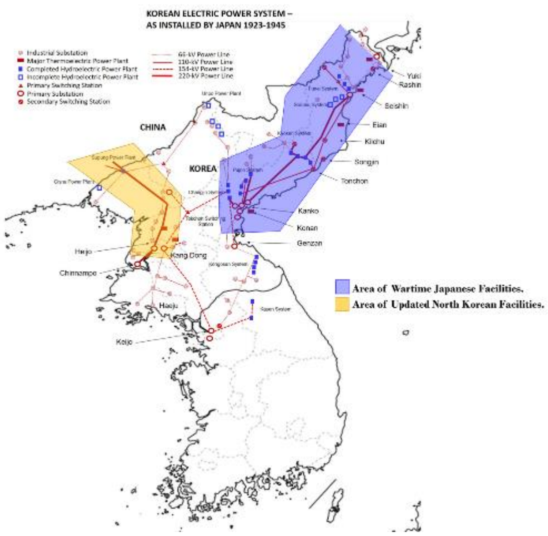
[121] The Electric Power Industry of North Korea. Provisional Intelligence Report. CIA/RR PR-148. (ORR Project 27.8789). Office of Research and Reports. Central Intelligence Agency. 21 September 1956

[122] Kim Il-Sung. Works 12. January-December 1958. Foreign Languages Publishing House. Pyongyang, Korea. 1983

[123] Electric Power of Korea. Strategic Engineering Study. S.E.S. 157. Engineer Research Office. North Atlantic Division. Corps of Engineers. Office, Chief of Engineers, US Army. February 1945. Record Group 331. Stack Area 290. Row 21. Compartment 22. Shelf 5. SCAP. General

The western grid, drawing most of its power from the huge Supung-ho Hydroelectric Powerplant installed on the Yalu River, transmitted electric power to the cities of and industries located at Nampo, Pusan, Pyongyang and Seoul.

Each of these grids, east and west, would eventually be tasked support the Japanese bomb program of WWII beginning in the 1940s, and the North Korean program beginning in the 1970s respectively. As it was, the east side of North Korea drew attention through the 1980s, as whispers of a Japanese program generally unknown to the world, continued to operate now under North Korean control. This included the Pon'gung Factory, a soybean factory that reinvented itself during WWII to become a Chemical fertilizer plant, or so we are told. [124] By 1943, the height of the Great Pacific War, it had 6,800 employees. [125] These formerly Japanese facilities were now solely attributed to North Korea, but were actually the scattered remains of the former Japanese quest for an atomic weapon. Though national-level power stations and grids provide support to nuclear research installations without which they could not function, it is the nation's distribution grid that actually suuports all nuclear facilities.



Power levels along a nation's national grid, at higher voltages usually fluctuate wildly and are oftentimes unstable. These fluctuating voltages can damage or destroy key enrichment equipment driving the cost of refining uranium even higher. Placing power lines underground only increases the problem and raises the costs associated with electric power transmission. Operations are also more difficult since the high reactive power of underground cables make voltage control more difficult.

An underground transmission line generally costs two to four times that of an overhead power line. For these reasons few electrical power systems extend transmission lines underground. It is likely that the Japanese would have extended an overhead transmission system with its transmission towers and higher voltage lines to the edge of any underground facility involved. This transmission line would then tie-in to a high-voltage transformer substation, either above- or underground which would then step the power down to lower voltage levels for use inside the underground facility. The major power transmission lines in the area of Hungnam were mapped by Army imagery interpreters during the war; there were two major substations located in the area of Hungnam. No newly constructed or additional and outlying transmission-level transformer substations were ever identified. There are however such features, or signatures, at the Sinanju Munitions Plant in Pyongan Namdo Province, North Korea.

Electrical power entering such facilities must be conditioned and stabilized before use. None of the equipment in use inside such a facility or with such processes involved in uranium enrichment require such high voltages. It is a fool's errand to rely on knowledge of a nation's national-level grids to locate a uranium enrichment program. Such facilities simply do not lay along the national grid. National-level substations within a known uranium enrichment plant are usually there to confirm to a viewer that what they seek, does exist. North Korea's Nyongbyon Nuclear Scientific Research Centre contains such a transformer substation, none of North Korea's other known research facilities bear such a blatant signature. The Sinanju Munitions Plant contains no such identifying transformer substation. The country's distribution system is extensive.

Distribution Grids:

The Japanese installed distribution system operated at 66,000 volts (66-kV). The distribution system transmitted power via alternating current (AC). 124 miles of the distribution-level power system was in-place by March 1931. The majority of this early distribution grid directly supported Nichitsu interests at Hungnam. While these grids are

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Subject File. 1943-1945. Box 8345. Folder – Korea 7. NND775019. The US National Archives and Records Administration, 8601 Adelphi Road, College Park, MD 20740-6001.

[124] Kim, Cheehyung Harrison. North Korea's Vinalon City: Industrialism as Socialist Everyday Life. Duke University Press. 2014

[125] Kim, Cheehyung Harrison. North Korea's Vinalon City: Industrialism as Socialist Everyday Life. Duke University Press. 2014

often, but not always supported by a connection to a country's national grid, the connection provided to a uranium enrichment production facility is always provided to a regional or local transmission facility – powerplant or transmission substation. As the distribution system expanded it served to deliver power transmitted from the peninsula's powerplants through the nation's grid to national-level substations where it was then stepped-down in voltage and distributed to cities, towns and industrial facilities. The power supplied was transformed to direct current (DC) on-site at these locations where necessary for use in such industries as the Nichitsu chemical combine at Hungnam. [126]

The 66-kV distribution system also extended directly from the peninsula's various power stations into local areas where demand existed. By March 1938 the distribution system had grown to a distance of about 1,491 miles. [127] The construction of another 450 miles of 66-kV power lines was planned for completion after 1939. [128] By 1939 12.5 percent of all Koreans had access to electrical power. [129] A sub-distribution system operating at 33-kV augmented the operations of the 66-kV distribution grid. When producing nuclear materials, a reliable and stable source of electrical power is the single-most important constant facing the production facility. Uranium enrichment facilities require access to large, stable, uninterruptible and reliable distribution-level power supplies produced by thermal or hydroelectric powerplants over a long period of time with some minimum level emergency back-up power resource constantly available. The key words are stable, uninterruptible, reliable, distribution-level and emergency back-up.

Redundancies in-depth:

The all-important requirement for stable electrical power is most often solved in two ways: By establishing a requirement for redundant independent power connections from the production plant back to the local and regional grid, or by collocating within the production facility, a series of emergency back-up generators. Most electric power providers solve the problem of redundant by providing a high degree of electrical power redundancy through multiple separate and independent connections back to the local or regional grid and then to the national grid, or by providing back-up electrical power generators. The more redundant electrical power connections extending from an identified facility back to the local or regional grid with or without emergency back-up generators, that exist, the greater the likelihood that facility observed is involved in the production of nuclear materials. Identifying these electrical power anomalies is the key to locating any nuclear materials production facilities. This redundancy can be comprised of:

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[126] Electric Power of Korea. Strategic Engineering Study. S.E.S. 157. Engineer Research Office. North Atlantic Division. Corps of Engineers. Office, Chief of Engineers, US Army. February 1945. Record Group 331. Stack Area 290. Row 21. Compartment 22. Shelf 5. SCAP. General Subject File. 1943-1945. Box 8345. Folder – Korea 7. NND775019. The US National Archives and Records Administration, 8601 Adelphi Road, College Park, MD 20740-6001.

[127] Electric Power of Korea. Strategic Engineering Study. S.E.S. 157. Engineer Research Office. North Atlantic Division. Corps of Engineers. Office, Chief of Engineers, US Army. February 1945. Record Group 331. Stack Area 290. Row 21. Compartment 22. Shelf 5. SCAP. General Subject File. 1943-1945. Box 8345. Folder – Korea 7. NND775019. The US National Archives and Records Administration, 8601 Adelphi Road, College Park, MD 20740-6001.

[128] Electric Power of Korea. Strategic Engineering Study. S.E.S. 157. Engineer Research Office. North Atlantic Division. Corps of Engineers. Office, Chief of Engineers, US Army. February 1945. Record Group 331. Stack Area 290. Row 21. Compartment 22. Shelf 5. SCAP. General Subject File. 1943-1945. Box 8345. Folder – Korea 7. NND775019. The US National Archives and Records Administration, 8601 Adelphi Road, College Park, MD 20740-6001.

[129] Electric Power of Korea. Strategic Engineering Study. S.E.S. 157. Engineer Research Office. North Atlantic Division. Corps of Engineers. Office, Chief of Engineers, US Army. February 1945. Record Group 331. Stack Area 290. Row 21. Compartment 22. Shelf 5. SCAP. General Subject File. 1943-1945. Box 8345. Folder – Korea 7. NND775019. The US National Archives and Records Administration, 8601 Adelphi Road, College Park, MD 20740-6001.

- A single-circuit distribution-level power line supported by back-up emergency generators.
- Multiple sets of distribution-level single-circuit power lines.
- A single double-circuit distribution-level power line.
- Multiple sets of distribution-level double-circuit power lines.
- The installation of multiple layers of emergency diesel electric power generators.

Ideally, this level of redundancy would be connected back to:

- A regional or distribution-level network substation.
- Multiple regional or distribution-level network substations.
- A national-level substation that steps power down to regional grid-level voltages for the facility in question.
- A nearby regional or national-level hydroelectric or thermoelectric powerplant.
- A purpose-built emergency power diesel electric generator(s).

All of the Imperial Japanese Navy's uranium enrichment plants in the area of Hamhung had such redundancies. As will be shown later, the Sinanju Munitions Plant is also supported by multiple levels of electrical power redundancy.

According to a Strategic Engineering Study, Electric Power of Korea, produced by the Corps of Engineers US Army in February 1945 "an abnormally large proportion of the Korean power production is absorbed by powerful industries, mines of various types, munitions factories, nitrogen plants," and so on located on the peninsula. [130] The facilities of Nichitsu alone were estimated to require 400,000 kilowatts. [131] As stated in the report "since most of the output is absorbed by mines, electrochemical and munitions plants, the load factor must be high. "[132] The load factor is the total energy consumed in a period (kWh) over maximum power that can be delivered (kW) into the number of hours (h) in that period. One watt is the rate at which work is done when one ampere (A) of current flows through an electrical potential difference of one volt (V).

While the amount of electrical power required to successfully operate a production facility of the size necessary to produce a Japanese uranium weapon was for the most part available on the peninsula, and the locations of those powerplants known, that electrical power resource existed only within finite limits over specific periods of time. Though the potential capacity to produce electricity in the amounts necessary to support such a large-scale uranium enrichment operation might have been available as indicated above, the electric power required to operate such an installation while supporting the other industries located on the peninsula was not – at least not of the size or capacities equaled by the Manhattan Project.

The Japanese constructed powerplants as they existed in Korea in 1940 were in-fact already over-tasked with supporting the Japanese industries then located on the peninsula, and could not support a large-scale uranium enrichment process and still meet the requirements of existing customers. It would fall to those power stations that came online after 1940 to support Japan's program such as the Supung, Sodusu and other plants that came online during the war. Japan never marched backwards. To Japan, the need to redirect all its electrical power resources into a uranium enrichment program never arose. Japan had planned its uranium program to fit within the bounds of the existing and planned network on the peninsula. When Japan established its program there was urgency but no emergency. After the Korean War, North Korea never had to face that conflict. Its immediate existence was secure, its long-term survival was however, always in question. For the leadership in Pyongyang in the 1950s, 60s, and 70s, there was no confusion about building an atomic bomb or nuclear weapon. North Korea needed a bomb to survive and continue the Kim line.

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[130] Electric Power of Korea. Strategic Engineering Study. S E.S. 157. Engineer Research Office. North Atlantic Division. Corps of Engineers. Office, Chief of Engineers, US Army. February 1945. Record Group 331. Stack Area 290. Row 21. Compartment 22. Shelf 5. SCAP. General Subject File. 1943-1945. Box 8345. Folder – Korea 7. NND775019. The US National Archives and Records Administration, 8601 Adelphi Road, College Park, MD 20740-6001.

[131] Port of Konan. Office of the Chief of Naval Operations, Division of Naval Intelligence. Navy Department. Washington D. C. OP-16-FE 26-45. March 1945. Record Group 226. Stack Area 190. Row 4. Compartment 5. Shelf 5. Entry 16. Box 1429. Document Number 124. NND750140. The US National Archives and Records Administration, 8601 Adelphi Road, College Park, MD 20740-6001.

[132] Electric Power of Korea. Strategic Engineering Study. S.E.S. 157. Engineer Research Office. North Atlantic Division. Corps of Engineers. Office, Chief of Engineers, US Army. February 1945. Record Group 331. Stack Area 290. Row 21. Compartment 22. Shelf 5. SCAP. General Subject File. 1943-1945. Box 8345. Folder – Korea 7. NND775019. The US National Archives and Records Administration, 8601 Adelphi Road, College Park, MD 20740-6001.

The amount of electrical power that could be produced at any one moment, over one week, one month or one year was limited. To develop a large-scale uranium enrichment process on the peninsula during the years proposed while operating most if not all other industries then located on the Korea Peninsula, required the ability to generate a level of power far beyond the installed production capacity of the powerplants then in operation.

Winning While Losing:
The demand for power required by a large-scale uranium enrichment process in Korea as with the US Manhattan Project, could only be achieved at the loss of electrical power to the other industries or industrial processes that also required access to that power over the same period of time. The Manhattan Project's Oak Ridge plant faced this same dilemma in fulfilling its electrical power requirements when it accessed the electrical power production capacity of the then continental US, most notably the electrical power produced by the Tennessee Valley Authority, (TVA) to enrich the uranium required for the bomb used at Hiroshima. The uranium production processes conducted at Oak Ridge during the latter part of WWII consumed fully one-seventh of all electrical power produced in the United States at that time. [133] Oak Ridge was supported by eight separate distribution-level 66-kV substations. The maximum peak electric power demand rate established for the facilities at Oak Ridge was 310,000 kilowatts. The highest demand rate ever recorded by the facility occurred on 1 September 1945 when demand reached 298,800 kilowatts. [134]

The electric power required to enrich uranium to weapons-grade material in the US came at the cost of providing that same electric power to the aluminum plants and steel mills which supported the wartime production necessary to win the war. Less aluminum and steel meant less bombers, fighter aircraft, tanks, ammunitions, carriers, rifles, bayonets, helmets, etc. Some argue that the resources dedicated to building the uranium bomb dropped on Hiroshima actually lengthened the war by diverting resources away from other weapons may have ended the war earlier.

In the US the War Production Board of WWII worked to balance demand against production, to ensure the amount of electrical power required to meet the challenges faced by the country could be achieved by the generating capacity available. The War Production Board managed the creation and development of new federally-owned electrical power production plants, transmission and distribution systems many of which supported the Manhattan Project.

Similar to the Manhattan Project, Japan's war planners recognized that electrical power was a resource. Like any other resource the amount of electrical power was limited; it had to be rationed and properly managed to meet the requirements of the industries supporting the war. More bullets could only be produced at the expense of some other needed commodity. Japan enacted similar controls but those controls may not have applied equally onto Korea where the Governors-General exercised authority.

Suzuki Tatsusaburo, a Japanese physicist involved in Japan's atomic bomb program stated in 2002 "One of our officers suggested we should scrap five or six heavy cruisers to make a 50,000-tonne facility." [135] As with ships it was a process of balancing the demands of the war against the resources available. While most researchers concentrate only on the Nichitsu complex those other major combines and industries then operating on the peninsula at that time; Mitsui, Mitsubishi, and RIKKEN would have been likewise adversely impacted if access to the normal level of electrical power support could not be maintained. Though the electrical power production capacity to enrich uranium to the level required for a bomb program may have existed in Korea, the decision to operate such a facility would have meant curtaining the operations of most other industries then operating on the peninsula. Like Nichitsu, the other industries that would have been shut down to operate a uranium enrichment program were also supporting the Japanese war effort.

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[133] Site Selection. Clinton Engineering Works (Oak Ridge). The Atomic Heritage Foundation. http://www. atomicheritage. org/index. php?Itemid=106&id=153&option=com_content&task=view
[134] Jones, Vincent C. Manhattan: The Army and the Atomic Bomb. Special Studies. Center of Military History. United States Army. Washington D.C., 1985.
[135] Hadfield, Peter. Dropping the nuclear bombshell. Japan Today. 7 August 2002.

As of 1939 more than 6,953 enterprises small or large were operating on the peninsula. [136] 149 of these enterprises employed 200 or more people while 5,676 employed 30 or less. With the reorganization mandated by the Commission on the Investigation of Countermeasures for the Current Situation most of these smaller shops now supported the larger combines, all of which worked in support of the war.

These small and large companies represented a considerable political and economic force governing the allocation of resources across the Korean Peninsula. The decision to operate a large-scale enrichment process of the size required to develop a uranium-based bomb would have required most existing munitions production facilities, crop irrigation systems, gun powder, steel mills, aluminum plants, magnesium refineries, coal mines, and so on, to cease regular operations while the uranium enrichment process was operating. This would in-fact occur when North Korea engaged its uranium enrichment facilities at the Sinanju Munitions Plant in 1988. The diversion of the electrical power required to support a large-scale uranium enrichment process would have included limiting power to the major population centers of Pusan, Pyongyang, Seoul, Hungnam, Chongjin and all remaining cities on the peninsula. Had these industries and population centers suffered a major diversion of electrical power, periods of massive long-term blackouts for weeks at a time, some record of the event would remain.

From the statements of POWs held at Inchon, Seoul, Hungnam and those prisoners passing through Pusan during the WWII, the writings of Japanese and Koreans living on the peninsula, no such blackouts are ever mentioned in Korea during the war. Not one POW affidavit taken at the end of the war ever mentions a rationing of electrical power to the industries where they labored. North Korea would never have that problem. Pyongyang had no customers to answer to, no one to please but the country's leadership. It defaulted on its debts abroad as it moved forward and like most poor nations of the 1970s on, was forgiven and new credit was once again extended. No matter the cost, North Korea's form of creeping gradualism always pressed onward. Forever forward.

To develop a uranium enrichment program of the size necessary to create an atomic bomb in time to alter the course of the war without interrupting the ongoing operations of existing industries would have required a high volume of excess electrical power production capacity. Though electrical power utilities normally maintain some level of excess production capacity, usually to manage periods of peak demand the excess capacity required to operate a uranium enrichment program in Korea while all other industries continued to operate, only existed in those power station planned or coming online in Korea during WWII.

The key difference in the ability of the US over that of Japan in producing a uranium-based weapon lay in the amount of excess electrical power production capacity available to the US throughout the war. During WWII the growing requirement for additional power in the US was met by the growth of privately-owned powerplants and the expansion of federally owned power stations. [137] In 1937 US production capacity stood at 42,000,000 kilowatts. From 1941 to 1945 the growth in Federally-owned capacity alone averaged 21 percent per year. Over the same period federally owned generation capacity grew by 27 percent per year. During the war the total US generation capacity grew at a rate of over 7. 5 percent annually. [138]

During the same period of time, the installed electrical power production capacity on the Korean Peninsula also expanded. In 1937 the installed capacity of Korean power stations stood at about 1,378,100 kilowatts. By 1943 US intelligence analysts estimated the total installed capacity of the Korean Peninsula at about 2,500,000 kilowatts; by 1945 the estimate had increased to roughly 3,000,000 kilowatts. But these numbers were based upon ideal conditions. As noted in the earliest Governors-General studies, weather impacted the power station's ability to reach maximum operating potentials. The Korean Peninsula suffered from no lack of adverse weather, periods of flooding and drought.

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[136] Korea, Parts I and II. Enemy Branch. Ministry of Economic Warfare. Copy Number 56. 8 December 1943. Record Group 226. Stack Area 190. Row 3. Compartment 28. Shelf 6. Entry 16. Box 853. File Number 70913. NND750140. The US National Archives and Records Administration, 8601 Adelphi Road, College Park, MD 20740-6001.

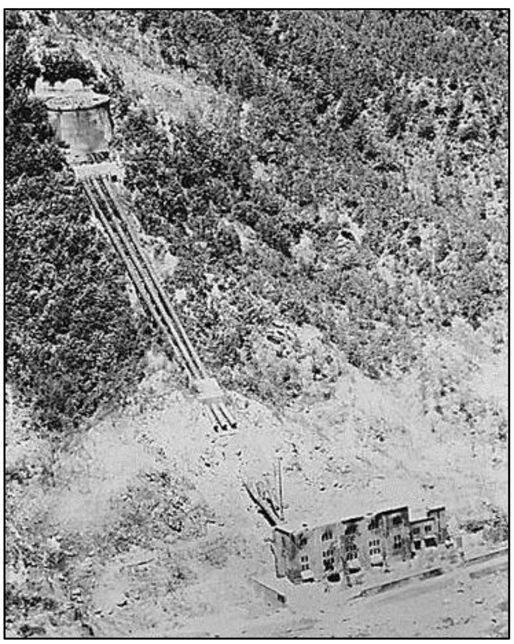
[137] Appendix A. History of the US Electric Power Industry, 1882-1991. The Changing Structure of the Electric Power Industry: An Update. Energy Information Administration, Office of Coal, Nuclear, Electric and Alternate Fuels. US Department of Energy, Washington, DC. December 1996

[138] Appendix A. History of the US Electric Power Industry, 1882-1991. The Changing Structure of the Electric Power Industry: An Update. Energy Information Administration, Office of Coal, Nuclear, Electric and Alternate Fuels. US Department of Energy, Washington, DC. December 1996

Droughts and drizzles:
Weather over the Korean Peninsula is highly dependent upon two factors; continental high-pressure air masses that develop over Siberia during the winter months pushing dry cold air down over the peninsula, and summer monsoons that force moist air northward over the Asian landmass. Most rainfall over the area falls across the southern part of the peninsula, far from the reservoirs and drainage areas that support the large-scale powerplants located in northern Korea.

A report produced by the British Ministry of Economic Warfare during the war divided the peninsula's rainfall map into three areas; a southern, a central and a northern area. The document reports yearly rainfall in the southern part of the peninsula at 57 inches, rainfall in the center of the country at 44 inches, and in the northern part a mere 32 inches. [139] Fully 70 percent of the rainfall over the Korean peninsula takes place from June to September each year. Korean winters bring less-than ten percent of the peninsula's annual precipitation. The remaining months of the year are fairly dry. Korea's hydroelectric power potential was therefore extremely dependent upon seasonal variations adversely impacting the ability of these plants to provide a stable, reliable source of electrical power.

The majority of powerplants built by Nichitsu before and during the war were located in some of the driest areas of the peninsula the country's far northeast. Electrical power is used as it is produced. As electrical power produced cannot be stored for future use, hydroelectric power stations manage overall annual production by storing large amounts of water in reservoirs for later use throughout the year. Production and consumption occur at the same time. The heavy rains taking place in the spring and summer of the year in Korea were held by large reservoirs as a reserve for use during the drier parts of the year. Rainfall and snowmelt replenish the water held in a reservoir for later use by the powerplant. Frequently these seasonal rains generate flooding that would overwhelm the capacity of the reservoir and deluge the powerplants located below. It was a problem the Japanese atomic energy and weapons research program only dealt with intensely for about the three years. It was however, a problem that North Korea dealt with for nearly three decades before they produced their first uranium tetrachloride. It was a process that the North Koreans learned the hard way.



At the end of WWII in August 1945 as the Soviet Red Army entered Korea, the Japanese in the northern part of the Korean Peninsula were rounded up, forced into concentration camps where they awaited eventual repatriation to Japan. Many thousands died in those camps. Many fled to the southern part of the peninsula. As Japanese were fleeing the north, other Japanese were fleeing the failed state of Manchukuo into Korea. There was a tremendous movement of Japanese across Northeast Asia. The loss of so many Japanese included the loss of most Japanese managerial and technical expertise. Koreans forced by the Japanese during their occupation of Korea north into the major industries in northeast Korea also fled, south, and home. As the Soviet Red Army stabilized the area, mostly by force, Korean Christians now fled south. The Koreans who remained, working in formerly low position jobs in the Japanese-owned industries were forced to step-up to higher management and technical jobs. It was a baptism under fire. As Korean communists returned to the country after years in China, Russia and elsewhere, purges would follow.

Most of these purges were locally operated, pitting communist against former landowners, government workers, and the bourgeois. Anger, petty jealousies, grudges and ancient feuds ruled the earliest purges. On 8 September 1948 northern Korea under Soviet Occupation became the Soviet-puppet state of North Korea. Two years later, on 25 Jun 1950, the Korean War began. All former Japanese-owned strategic industries were destroyed by US bombers

[139] Korea, Parts I and II. Enemy Branch. Ministry of Economic Warfare. Copy Number 56. 8 December 1943. Record Group 226. Stack Area 190. Row 3. Compartment 28. Shelf 6. Entry 16. Box 853. File Number 70913. NND750140. The US National Archives and Records Administration, 8601 Adelphi Road, College Park, MD 20740-6001.

operating under the flag of the United Nations. By October 1950 there were no strategic targets left in North Korea. For two years after the start of the war, the country's electrical power system did not suffer concentrated attack.

Bombing the North Korean Electrical Power System:
On 23 June 1952 in the largest single strike of the Korean War more than 500 aircraft from the Air Force, the Navy and Marine Corps attacked the Japanese installed powerplants supporting the North Korean war machine. US Navy aircraft severely damaged the Supung Hydroelectric Powerplant and the Kyosen system, while Air Force and Marine units damaged the lower-level plants of the Fusen and Chosin systems. The next day Air Force units returned to the Chosin and Fusen systems to attack the first and second plants in the Chosin System and to reengage the lower-level plants of the Fusen system. These raids were followed up on the 26^{th} of June with attacks on the Chosin and Fusen system, mostly concentrating on the system's upper-level plants. About 90 percent of the Japanese installed electric power systems were destroyed. Follow-up attacks launched throughout the remainder of the war prevented North Korea from bringing the plants back on-line. After the Korean War, North Korea's East Bloc allies returned the systems to service. Plans were to bring the Supung Hydroelectric Power Station back online by 1956 with a total generating capacity of 600 MW. One of the goals of North Korea's first Five-Year Plan was to rebuild all its former Japanese-installed hydroelectric power station. At that time, a rebuilt Supung could meet half the demand of one-half the country's industrial needs.

As the war ended in July 1953, purges returned the next month in August. First to go were those members of the domestic faction who, for the most part, had never fled Japanese Occupied Korea for China, the Soviet Union, or elsewhere. In the aftermath of the Korean War, the Soviet Union and its East Bloc allies rebuilt most of North Korea's former Japanese heavy industrial base to include the former Nichitsu operations in Hamhung/Hungnam, the country's electrical power systems and so on. Nichitsu interests were also present in Kanggye, Chongjin, Anju and Sinanju. In 1955 Kim Il-sung indicated that a purge of the Yan'an (Chinese oriented) and the Soviet-Korean faction were imminent.

By 1959, the purges had been so ravaging that more than a quarter of seats in the Supreme People's Assembly were vacant. A special by-election had to be organized in July that year. By 1961, the only faction left was Kim Il-sung's own Guerrilla faction, along with members who had joined the WPK under Kim Il-sung's leadership and were loyal to him. In the 1961 Central Committee, there were only two members of the Soviet faction, three members of the Yan'an faction and three members of the Domestic faction left out of a total Central Committee membership of 68. Though we hear about events in Pyongyang regarding the purges but, the purges also extended to the provincial and county-level also. There they were more apt to get out of control, resulting in imprisonment or mob justice. The point here is not to recount all of North Korea's history but to recount the constant instability. In a period of less-than 20 years after the end of WWII, North Korea's industrial management and technically competent contingent of Japanese-mimicking Korean personnel were proven survivors, rising to the challenges of collapses in the face of ever-changing political winds. Younger men, educated in North Korea or abroad soon began to fill the ranks of industry across the land. They would rely heavily on this flexibility over the next thirty years as the country's leadership led the nation into a uranium enrichment program resulting in a fission bomb.

Back-Up Power:
For Japanese-owned industries conducting operations on the Korean Peninsula, a source of emergency back-up power sufficient to shut down on-going operations when power from the national- or distribution-level grid was interrupted was a requirement. Under the Japanese all chemical plants, steel mills, cement plants located on the peninsula maintained some level of emergency back-up electrical power system. A uranium enrichment process also comes with a requirement for backup power to support emergency shutdown. Back-up electrical power support was required to permit the safe shutdown of operating equipment when access to national- and distribution-level state-owned and provided power abruptly – vanished. These backup powerplants did not possess the capacity to support continued industrial plant operations until such grid power was restored but, were large enough to support shut down operations when stable power suddenly vanished. Most strategic industries possessed such plants. Nichitsu maintained such a power station.

Nichitsu's on-site emergency back-up power system consisted of a single Standley thermal plant rated at 14,000 kilowatts. The plant was installed during site construction between 1928 and 1930 and was never upgraded. Had the fertilizer plant itself been the location of a large-scale uranium enrichment plant it would have lacked sufficient back-up power to allow the safe shutdown of a large-scale uranium enrichment operation. Other Nichitsu industries outside the main nitrogen fixation plant at Hungnam, which was thought to be involved with Japan's atomic energy and weapons research program, had larger, permanent on-site small-scale power stations. Uranium enrichment facilities would have larger, much more stable electrical power backup systems, large enough to continue operations when power from the nation- or regional-grid failed, sufficient to allow operations to slowly shut down. Such systems would eventually support the Showa Shu Ri Kumiai in North Korea as the Japanese had intended but, the small generators initially installed were too slight to provide backup for the entire operation when all of its capacity was running at the same time. A much larger backup system would not be installed completely until 1976, and then it would be China and the Soviet Union probably naively, that constructed the Sinanju Munitions Plant's backup power source.

The Emperor's Irrigation Project:
The Showa Shu Ri Kumiai was established in 1938 ostensibly to increase rice production in the growing regions of Pyongan Namdo; the area of Anju, Kaechon, Sunchon, Pyongwon and Taedong counties. [140] The organization was subordinate to the Agricultural Society of Pyongan Namdo and took all necessary preparatory steps required to establish the irrigation project to include land surveys and initial construction however, the work required by the sheer scale of the project was too large and work proceeded gradually.

The goal of the project was to distribute water to rice fields and the reclaimed land that comprised much of the area of Pyongan Namdo. The area to be irrigated covered 61,275 acres give or take. The project would culminate with a semicircular underground water irrigation system, that provided water to the fields, along miles of underground water tunnels. At least two tunnels were built, one being 10 meters wide and buried seven meters deep; the second was eight meters wide and also buried seven meters deep. [141]

One tunnel extends from the northwestern side of the Yongpung Reservoir to the Kumsong-ni Pumping Station in the Anju subdistrict of Anju located 32 kilometers to the west, where more water was gathered from the Ch'ongch'on River, suggesting that, this feed does not support the uranium enrichment process at the Sinanju Munitions Plant. Water from the Ch'ongch'on River would carry too much dirt and other accumulated heat. The other water tunnel extends from the southwestern end of reservoir to the Haseo Pumping Station at Songchung-ni, in the Haseo District of Pyongwon County. It is likely that this water tunnel extends underneath the Sinanju Munitions Plant. The Kumsong-ni Pumping Station was equipped with five 500 horsepower pumps and was referred to as the same. The 8th Section Works was also equipped with five 500 horsepower pumps and located in Haseo District of Pyongwon County, could probably kept in the dark about ongoing work at the Sinanju Munitions Plant.

Other buried water tunnels and piping would extend from the two larger pumping stations to smaller stations where they would feed water into surrounding the rice paddies. It was a great way to irrigate the fields, it would also be a great way to dissipate waste heat generated from an underground uranium enrichment process such as an EMIS. Such enrichment plants are extremely inefficient and release a large amount of heat. [142]

The project was known by the Japanese as the largest civil engineering project in Korea, the second largest civil engineering in the empire outside a similar irrigation project located in Taiwan. Larger than even Japan's Supung power station on the Yalu River. As circumstances, probably related to the Great Pacific War, became more critical, work on the project was suspended for some time. [143] At the end of 1943 however, the project was revived by the Korea Farm Land Development Corporation to increase the extent of water irrigation into the area of Pyongan

[140] Irrigation Works, Pyongan Namdo. KMAG (Korea Military Advisory Group) Liaison Office. 4302. 0300. North Korea. TB 2582 4671. T. I, G-2, Headquarters, Far East Command. Confidential Informant. 10 December 1949. Bibliographic ID (link to National Diet Library Online) digidepo_3540683 pdf-Anju
[141] Irrigation Works, Pyongan Namdo. KMAG (Korea Military Advisory Group) Liaison Office. 4302. 0300. North Korea. TB 2582 4671. T. I, G-2, Headquarters, Far East Command. Confidential Informant. 10 December 1949. Bibliographic ID (link to National Diet Library Online) digidepo_3540683 pdf-Anju
[142] McGoldrick, Fred. Seongwhun Cheon, and Jon B. Wolfsthal. The North Korean Uranium Enrichment Program: A Freeze and Beyond. VERIFYING NORTH KOREAN NUCLEAR DISARMAMENT. Carnegie Endowment for International Peace. 2003
[143] Irrigation Works, Pyongan Namdo. KMAG (Korea Military Advisory Group) Liaison Office. 4302. 0300. North Korea. TB 2582 4671. T. I, G-2, Headquarters, Far East Command. Confidential Informant. 10 December 1949. Bibliographic ID (link to National Diet Library Online) digidepo_3540683 pdf-Anju

Namdo. [144] Due to shortages related to wartime conditions, the Japanese effort continued to progress slowly. Little is known of the Korea Farm Land Development Corporation, it appears to have been part of a government program or operated underneath a bureau of the Governors-General of Korea lost like Japanese Army. On 15 August 1945, work on the project stopped completely. Work on the project would actually however, never stop at all. Not for all the years and decades to follow.

In January 1946 after the northern part of Korea was liberated, what was seen at the time as the “North Korean Puppet Government,” established the Anju Water Utilization Construction Works. There is nothing quite like a name change.

According to Kim Il-sung in his speeches, the project did not begin until 1948. Kim probably lied and shortened the timeframe of the irrigation project to boost statistics. If not that then, it may be that in 1946, Kim was not actually aware of the construction project. [145] When Kim returned to Korea in 1945, he was no longer even fluent in Hangul, the language of the country. He had not even been there for 20 years. It wasn’t until December 1945, that the Soviets actually installed Kim as chairman of the North Korean branch of the Korean Communist Party. In Kim’s 50-volume Works, he did not mention Anju or Sinanju until July 1946. [146] Originally, the Soviets preferred Cho Man-sik, but Cho refused to support any UN-backed trusteeship and clashed with Kim. In January 1946 Cho was imprisoned in Pyongyang, where confirmed reports of him end. He is generally believed to have been executed along with other political prisoners during the early days of the Korean War, possibly in October 1950.

Cho’s removal opened the way for Kim Il-sung to consolidate his power in the north, a position he was able to hold for 48 years until his death in 1994.

Historical records reveal that the security and survival of the North Korean regime has been closely linked to the nuclear activities from the first days of its existence. Toady that he was, to demonstrate his personal loyalty to the ever-suspicious and aging Soviet dictator Stalin in 1947, when the latter was still undecided as to who should be appointed as the future leader of the northern Korean communist state, his front-running protégé Kim Il-sung upon the recommendation of his handlers at the Soviet Occupation Administration invited a team of Soviet scientists to conduct a geological survey of monazite mines and uranium ore deposits. [147] The results of the survey confirmed the substantial radioactive natural deposits discovered by the Japanese geologists in the northern part of the Korean peninsula in the late 1930s, which could be cheaply exploited for the benefit of the burgeoning Soviet atomic industry. Kim Il-sung received praise from Stalin and a vote of confidence: In September 8, 1948, Moscow’s man was elected as the first leader of the newly founded Democratic People’s Republic of Korea. [148]

What is interesting about these early pre-war signs of Kim Il Sung’s emerging fascination in nuclear activities, is that they had nothing to do with the search for alternative sources of energy generation or economic development. [149] They had nothing to with North Korea’s generating capacity of 1945. It was always about atomic weapons and would always remain thus.

6,192,000 man-days:

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[144] Irrigation Works, Pyongan Namdo. KMAG (Korea Military Advisory Group) Liaison Office. 4302. 0300. North Korea. TB 2582 4671. T. I, G-2, Headquarters, Far East Command. Confidential Informant. 10 December 1949. Bibliographic ID (link to National Diet Library Online) digidepo_3540683 pdf-Anju

[145] Let Us Complete the Phyongnam Irrigation Project Quickly. Concluding Speech at a Small Meeting of the Cabinet of the Democratic Peol. 1 July 1955. contained in Kim Il Sung. Works. Volume 9. July 1954 – December 1955. Foreign Languages Publishing House. Pyongyang, Korea. 1982

[146] I congratulate the First Result in Building the Democratic Capital. Speech at the Celebration of the Pothong River Improvement Project. 21 July 1946. contained in Kim Il Sung. Works. Volume 2. January– December 1946. Foreign Languages Publishing House. Pyongyang, Korea. 1981

[147] *Letter from Soviet Ambassador to the DPRK Terentiy Shtykov to Stalin*, dated March 12, 1949, The Archive of Foreign Policy of the Russian Federation, fond 07, opis 22a, delo 223, papka

[148] Mansourov, Alexandre. Soviet Occupation and Early Traces of North Korea’s Nuclear Activities. North Korea’s Road to the Atomic Bomb. International Journal of Korean Unification Studies, Vol. 13, No. 1, 2004.

[149] Mansourov, Alexandre. Soviet Occupation and Early Traces of North Korea’s Nuclear Activities. North Korea’s Road to the Atomic Bomb. International Journal of Korean Unification Studies, Vol. 13, No. 1, 2004.

In a 1954 speech by Kim Il-sung, the Water Utilization Construction Works project was to irrigate the entire area of Anju, Mundok, Suchon and Pyongwon counties in Pyongan Namdo. [150] Kim ordered the State Construction Commission and the Ministry of National Defense to hand over construction machines and equipment required by the Ministry of Agriculture. [151] Kim had now tied the project to the Ministry of National Defense. Small wonder. Of course, after the Korean War, Kim would conduct many on-the-spot inspections of the project, providing personal guidance to the workers and project managers and taking credit.

Kim never mentioned any underground facilities, aqueducts or water tunnels in any of his speeches but, in January 1956 he did advise the Bureau of Irrigation Administration to stop producing pumps, and produce more wheelbarrows for the various irrigation projects. [152] Oddly enough, Kim's speech took place months after the Anju Water Utilization Construction Works was announced as finished. Kim only spoke of the "first stage" of construction as being complete. [153] Nearly ten years into its construction, what part of the project remained incomplete?

The Anju Water Utilization Construction Works was subordinate to the Irrigation Control Office of Pyongan Namdo Province, Department of Irrigation Control Works of the Ministry of Agriculture and Forestry, North Korea. Lengthy titles are of great importance to governments in general, and North Korea in particular in the early days of the regime.

According to reports, there were only 500 paid workers on the project. The number does not include any military personnel and apparently there were no troops assigned to the project. Manpower however, would not be an issue.

Altogether it was planned that 50,000 laborers would be enlisted from the provinces to support the project. The workers were to be mobilized daily. Each family in the provinces of Pyongan Namdo, Chaggang-do, the area of Hwanghae, and the city of Pyongyang were required to provide one worker each year to labor on the project for a total of 40 days. [154] Worse yet, each farm house in the immediate districts were required to house one or two of the displaced laborers. [155] 800-gram rations were provided to each worker per day, 40% composed of white rice, 60% miscellaneous grains, [156] probably corn and wheat. Oddly enough, each worker was given 10 North Korean Won for dishes to accompany the various grains. [157] In the end, the report indicated that only 40,000 men had worked on the project.

In a speech given by Kim Il-sung in 1957 he said that workers had "devoted 6,192,000 man-days" to complete the project. [158] The working age citizens of Anju, Mundok, Phyongon and Sukch'on had each contributed 100-man days

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[150] Let Us Complete the Phyongnam Irrigation Project Quickly. Concluding Speech at a Small Meeting of the Cabinet of the Democratic Peol. 1 July 1955. contained in Kim Il Sung. Works. Volume 9. July 1954 – December 1955. Foreign Languages Publishing House. Pyongyang, Korea. 1982

[151] Let Us Complete the Phyongnam Irrigation Project Quickly. Concluding Speech at a Small Meeting of the Cabinet of the Democratic Peol. 1 July 1955. contained in Kim Il Sung. Works. Volume 9. July 1954 – December 1955. Foreign Languages Publishing House. Pyongyang, Korea. 1982

[152] (3) On the Mechanization of Construction. For Radical Change in Construction Work. Speech at a National Conference of Architects and Builders. 20 January 1956. contained in Kim Il Sung. Works. Volume 10. January – December 1956. Foreign Languages Publishing House. Pyongyang, Korea. 1982

[153] (3) On the Mechanization of Construction. For Radical Change in Construction Work. Speech at a National Conference of Architects and Builders. 20 January 1956. contained in Kim Il Sung. Works. Volume 10. January – December 1956. Foreign Languages Publishing House. Pyongyang, Korea. 1982

[154] Irrigation Works, Pyongan Namdo. KMAG (Korea Military Advisory Group) Liaison Office. 4302. 0300. North Korea. TB 2582 4671. T. I, G-2, Headquarters, Far East Command. Confidential Informant. 10 December 1949. Bibliographic ID (link to National Diet Library Online) digidepo_3540683 pdf-Anju

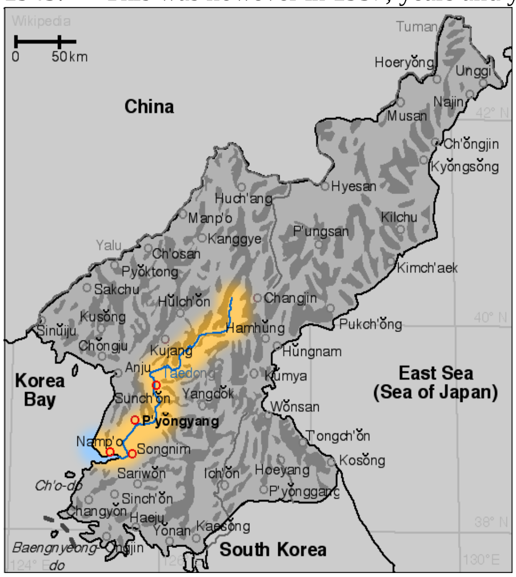
[155] Irrigation Works, Pyongan Namdo. KMAG (Korea Military Advisory Group) Liaison Office. 4302. 0300. North Korea. TB 2582 4671. T. I, G-2, Headquarters, Far East Command. Confidential Informant. 10 December 1949. Bibliographic ID (link to National Diet Library Online) digidepo_3540683 pdf-Anju

[156] Irrigation Works, Pyongan Namdo. KMAG (Korea Military Advisory Group) Liaison Office. 4302. 0300. North Korea. TB 2582 4671. T. I, G-2, Headquarters, Far East Command. Confidential Informant. 10 December 1949. Bibliographic ID (link to National Diet Library Online) digidepo_3540683 pdf-Anju

[157] Irrigation Works, Pyongan Namdo. KMAG (Korea Military Advisory Group) Liaison Office. 4302. 0300. North Korea. TB 2582 4671. T. I, G-2, Headquarters, Far East Command. Confidential Informant. 10 December 1949. Bibliographic ID (link to National Diet Library Online) digidepo_3540683 pdf-Anju

[158] On Further Expansion of Irrigation Facilities. On Some Problems for Future Development of Agriculture. Speech at a Meeting of Managerial Workers of Agricultural Cooperatives in South Phyongan Province. 21 January 1957. contained in Kim Il Sung. Works. Volume 11. January – December 1957. Foreign Languages Publishing House. Pyongyang, Korea. 1982

to the project. [159] The counties of Junghwa, Jungsan, Kangnam, Sungho and Taedong has also provided workers: Levee en masse. [160] Three months each over some period of years. According to Kim Il-sung, this single project alone would irrigate more land area than all the various Japanese “irrigation associations” constructed from 1928 to 1945. [161] This was however in 1957, years and years before the project would ever be completed. The requirement for electrical power was similarly elaborate.



Once complete, 11 transformer substations would dot the area. 38 transformers would be installed. Three of the transformer substations would distribute power at 66-kV, the primary kilovolt range that supports uranium enrichment processes. [162] These three substations would contain 15 transformers. The substation at Kaechon would hold six. The remaining eight transformer substations would receive power at 22-kV. [163] Most of these substations would hold three transformers. In addition to water irrigation, these substations probably supported local area electrical power demand.

The Course of Japan:

As had the Manhattan Project with its facilities at Oak Ridge, Tennessee and Hanford in Washington state, Japan, and later a North Korea following through on Japanese plans, would need a source of clean, cold, water. That far west, the Ch’ongch’on River carried too much sand and dirt as it widened and neared the Yellow Sea. That far north, and a bit east of the Anju Water Utilization Construction Works, lay the northerly reaches of the Taedong River.

The Anju Water Utilization Construction Works immediately began work on the project’s water reservoir near Unhung-ni, a few miles east of Anju, west of Kaechon, in the Tong Myon subdistrict of Anju-gun (county), Pyongan Namdo Province, North Korea. A cable line was with a 150-horsepower motor was installed at the dam site that extended from there to the Ch’ongch’on River. The tramway hauled sand and gravel from the river to the dam site where it was mixed with concrete to build the dam. [164] 18 gasoline-powered locomotives were also used to haul sand and gravel from the river to the construction site. [165] When work began, it was thought possible that the project could be completed by the end of December 1951. [166] It was the first actual step taken in the reinvigoration of the former Japanese project. WWII had ended only fourth months earlier in August 1945. Five years later in 1950, during the Korean War (1950-1953), the Republic of Korea (ROK) II Corps would deploy its 16th and 21st Regiments of the

[159] On Further Expansion of Irrigation Facilities. On Some Problems for Future Development of Agriculture. Speech at a Meeting of Managerial Workers of Agricultural Cooperatives in South Phyongan Province. 21 January 1957. contained in Kim Il Sung. Works. Volume 11. January – December 1957. Foreign Languages Publishing House. Pyongyang, Korea. 1982

[160] On Further Expansion of Irrigation Facilities. On Some Problems for Future Development of Agriculture. Speech at a Meeting of Managerial Workers of Agricultural Cooperatives in South Phyongan Province. 21 January 1957. contained in Kim Il Sung. Works. Volume 11. January – December 1957. Foreign Languages Publishing House. Pyongyang, Korea. 1982

[161] Irrigation Works, Pyongan Namdo. KMAG (Korea Military Advisory Group) Liaison Office. 4302. 0300. North Korea. TB 2582 4671. T. I, G-2, Headquarters, Far East Command. Confidential Informant. 10 December 1949. Bibliographic ID (link to National Diet Library Online) digidepo_3540683 pdf-Anju

[162] Irrigation Works, Pyongan Namdo. KMAG (Korea Military Advisory Group) Liaison Office. 4302. 0300. North Korea. TB 2582 4671. T. I, G-2, Headquarters, Far East Command. Confidential Informant. 10 December 1949. Bibliographic ID (link to National Diet Library Online) digidepo_3540683 pdf-Anju

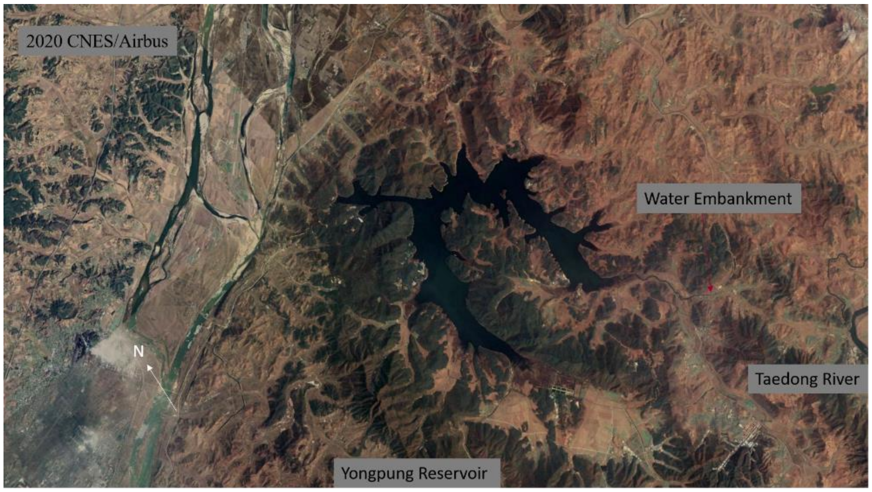
[163] Irrigation Works, Pyongan Namdo. KMAG (Korea Military Advisory Group) Liaison Office. 4302. 0300. North Korea. TB 2582 4671. T. I, G-2, Headquarters, Far East Command. Confidential Informant. 10 December 1949. Bibliographic ID (link to National Diet Library Online) digidepo_3540683 pdf-Anju

[164] Irrigation Works, Pyongan Namdo. KMAG (Korea Military Advisory Group) Liaison Office. 4302. 0300. North Korea. TB 2582 4671. T. I, G-2, Headquarters, Far East Command. Confidential Informant. 10 December 1949. Bibliographic ID (link to National Diet Library Online) digidepo_3540683 pdf-Anju

[165] Irrigation Works, Pyongan Namdo. KMAG (Korea Military Advisory Group) Liaison Office. 4302. 0300. North Korea. TB 2582 4671. T. I, G-2, Headquarters, Far East Command. Confidential Informant. 10 December 1949. Bibliographic ID (link to National Diet Library Online) digidepo_3540683 pdf-Anju

[166] Irrigation Works, Pyongan Namdo. KMAG (Korea Military Advisory Group) Liaison Office. 4302. 0300. North Korea. TB 2582 4671. T. I, G-2, Headquarters, Far East Command. Confidential Informant. 10 December 1949. Bibliographic ID (link to National Diet Library Online) digidepo_3540683 pdf-Anju

ROK 8th Division in front of Unhung-ni north of the Ch'ongch'on River. [167] The area was the scene of bloody fighting. Though ROK and US forces were there, nearly onsite, there are apparently, no documents investigating the area's irrigation system. Once the dam was completed, water would be diverted in into the reservoir not from the nearby Ch'ongch'on River but, from the Taedong River.



To quote the document, "an embankment 250-meters wide and 2 meters deep has been constructed on the upstream side of the Taedong River at Kwantok Ni, Chungso Myong, Kechon Gun." The problem in relating the report to imagery were the words, "an embankment 250-meters wide," the embankment wasn't actually an embankment, it was a channel, and it was not 250-meters wide, it was 250-meters long (it would eventually extend about 600-meters). Maps of the time were useless. Produced in 1947, none of the features mentioned would appear on a US map of the area until the late 1950s, early 1960s. Most of the earliest mapping of the Korea was done during the period of the Japanese Occupation of peninsula. These Japanese maps formed the basic foundations of all maps used during the Korean War by the US, China and Britain. Members of a geological study being organized by the Soviet Ministry of Geology in Moscow, probably used the same base map.[168] The first topographic maps produced by the ROK over the period 1950 to 1957 were direct copies of the original Japanese map produced from the original Japanese etched plates. By the time plates had been updated and produced, the Korea Military Advisory Group's report on the Irrigation Works, Pyongan Namdo, would be about 10 years old and gathering dust in some file cabinet, if anyone had it at all.

On the original Japanese plates used to produce maps in 1945 and during the Korean War, there was no sign of the dam constructed at Unhung-ni, the reservoir or its canal. When the new edition of the map was produced, the lake was there. Only a close comparison of the two maps side-by-side, or one overlaying the other on some light table, would have revealed the existence of the new reservoir. No one seems to have ever done that. Long-term change-over-time is one of the few methodologies that exist to locate and identify the components of a nuclear weapons programs. The only way to identify the extent of the 1940s project today, would be to go backward in time to imagery taken of the area as it began examining everything available through its entire construction period; a capability that may not exist in today's environment of digitized imagery, accompanied by an abhorrence of history,

[167] Korea Institute of Military History. The Korean War, Volume Two. University of Nebraska Press. Lincoln and London. 2001
[168] Top secret. April 25, 1947 Protocol No. 36 of a Meeting of the Special Committee under the Council of Ministers of the Soviet Union (Excerpt). Special dossier. Members of the Special Committee: Coms. Beria, Malenkov, Voznesenskii, Zavenyagin, Kurchatov, Makhnev, Pervukhin.

and the CNN moment. It is likely that, as the uranium works progressed, that the irrigation project was further altered to hide any heat signature appearing in the irrigated fields.

The first thermal imaging system was developed in the 1930s. The earliest successful thermal imagery scanners were referred to as thermographs. The US Army built the first thermograph in the US using a 16-inch searchlight reflector, a dual-axis scanner and a bolometer detector. [169] From 1956 to 1960, the US Army provided the main support for the advancement of thermal imagery worldwide. The first aerial thermal imagery platforms flew in 1965 and later became heavily relied upon during the War in Vietnam. It should have been used over North Korea, Kim Il-sung had determined the country's eventual uranium enrichment project to be a national goal as early as 1945 and – no one noticed.

In watching the events surrounding the collapse of the Soviet Union and the fall of the Berlin Wall, most IC analysts believed that North Korea's electrical power system – old and antiquated – had simply collapsed, forcing the country's heavy industries into failure and destroying the country's economy. Like much of the IC's analysis of North Korea's uranium enrichment infrastructure however, that line-of-reasoning could not withstand intense review. This was the same IC that, in the 1980s assumed North Korea could never master the technologies required to build a bomb even though those technologies were now 50 years old, the same IC that failed to predict that North Korea could ever build an intercontinental ballistic missile and the same North Korea they would argue could never mate a working missile to a submarine launch pad. What the IC really failed to understand was far more complex: Kim Il-sung had wanted the atomic bomb since 15 August 1945 and would be ruthless in his pursuit of the weapon.

The Great Leader:

Kim Il-sung had been born in Pyongyang early in the Japanese occupation and grew up under the split-toed shoe of the occupying Japanese. He had matured to a young man during the Japanese Occupation of Korea (1905-1945) where he found himself a second-class citizen in his own country. As a young man he publicly railed against the Japanese. In 1929 Japanese police learned of his activities and Kim was jailed. Unlike Mahatma Gandhi who adopted nonviolent civil disobedience as a means of resistance to British rule over India, Kim instead turned to violence and eventually took up arms to force the Japanese out of Korea. Kim Il-sung became consumed with forcing the Japanese out of Korea and would be likewise, consumed with acquiring a nuclear weapons capability.

In 1931 Kim joined the Communist Party of China – the Communist Party of Korea (CPK) had been founded in 1925, but the CPK had been thrown out of the Soviet-sponsored Communist International, the Comintern, in the early 1930s, for being too nationalistic. Kim later joined various anti-Japanese guerrilla groups in northern China and eventually wound up in the Soviet Union, where he rose to the ranks to Major in the Soviet Red Army, eventually returning to Korea to rule what would become North Korea. Kim's desire for an atomic bomb grew out of the events at Hiroshima and Nagasaki, Japan that ended WWII on 15 August 1945. To Kim, it was not the Soviet Red Army, not US forces battling across the Pacific but the atomic bomb that ended Japanese rule over the Korean Peninsula.

To Kim Il Sung, mighty Japan, the overbearing Japanese, had been toppled from their pedestal atop Asia and destroyed, not by the US; but by the atomic bomb. Anyone who possessed that power was capable of defending a united Korea against its more powerful neighbors Russia, China and the offshore power of Japan, now an American puppet. It was the idea of a unified Korea, a common culture, eventually nuclear-armed, that led to Kim's ill-fated attempt to unify the peninsula under his rule in 1950. What Kim Il-sung learned from the Korean War was not that America could defeat the North Korean Army, but that an independent Korea could not stand alone against the greater powers that surrounded it, unified or not, without an atomic bomb. Kim was so glued to the atomic bomb that, long after most weapons became referred to as nuclear, in Kim's mind, that always remained an atomic bomb.

[169] Lloyd, J.M. Thermal Imaging Systems. Springer. 1975

He would not begin to use the term "nuclear" or a regular basis until 1986, 41 years after Hiroshima. The Korean War only reinforced Kim's earlier understanding of Korea's position vis-à-vis its more powerful neighbors.

In the aftermath of the Korean War Kim Il-sung quickly rid North Korea of any home-grown Korean communist who might oppose him. He later rid the country of its Soviet and communist Chinese advisers who had sidelined him during the Korean War.[170] Those North Koreans who favored a Soviet- or Chinese-styled communism were also purged – executed, sent into exile or internal concentration camps. North Korea's future would not be decided by agreement or consensus, but by the decisions of only one man; Kim Il-sung – and he was bent on acquiring atomic weapons no matter the costs. Though probably written out of North Korean history, the Soviet Union and the East Bloc aided in the construction of the Anju Water Utilization Construction Works. In fact, it may have been undertaken as a Soviet initiative, if it was though, it was a bad choice on their part.

In a journal maintained by Soviet Ambassador to North Korea A.M. Puzanov, he chronicled Soviet and East Bloc assistance to the project. From the Journal of Soviet Ambassador in the DPRK Cde. A. M. PUZANOV from 12 through 30 September 1960 Pyongyang, 15-16 September 1960: [171]

> I visited and inspected the main structures of the Anju irrigation system together with Chief of the DPRK MFA 1 Department and Embassy Third Secretary D. A. Priyemsky: the spillway on the Taedong River; the Yenpkhun [sic] Reservoir, and the water intake on the Chkhonchkhon [sic] River.
>
> During the construction of the Anju irrigation system the Soviet Union and other socialist countries gave technical assistance and aid with construction materials and equipment. A group of Soviet specialists headed by engineer Belikov gave practical assistance right at the construction site. Eight 28-inch pumps, eight 415-hp electric motors each were delivered for the Kymson [sic] pumping station on the Chkhonchkhon [sic] River and other electrical and construction equipment.
>
> The construction of the irrigation system was begun in the period of the Japanese occupation of Korea in 1919; when this was being done provision was made to irrigate an area of 12,000 jeongbo. However, the Japanese managed to perform only a part of the construction work, less than one-fifth.
>
> After the liberation of Korea by the Soviet Army by decision of the DPRK government construction of the Anju irrigation system was continued in September 1948. The construction was about 40% done. Construction was stopped during the war. Some of what had been done remained intact.
>
> In August 1954 the DPRK government decided to construct an irrigation system in two stages between 1954 and 1957. It was intended to irrigate about 30,000 jeongbo.
>
> Construction of the irrigation system was finished ahead of schedule, on 22 May 1956, that is, in a very short period, one year and 10 months, thanks to the selfless labor of the manual laborers, officer workers, peasants, students and KNA soldiers, and also units of the Chinese People's Volunteers.
>
> The waters of the Anju irrigation system are now used by 92 agricultural cooperatives, which unite 45,755 peasant households and irrigate more than 44,000 jeongbo of flooded and waterless fields of the districts of Anju, Mundok, Pkhenwon [sic], and Sukchkhon [sic], located in the Yel'tusamchkhonni [sic] Valley. Before the start of construction cultivated plots on the territory of the above districts was 66,500 jeongbo, including 38,400 jeongbo of rice fields, of which 70% did not have reliable irrigation. Thanks to the steady irrigation the rice yield will grow annually and this year an average of up to 4-4.5 tons per jeongbo will be collected instead of the 1.5-1.7 collected before the construction of the system.
>
> An interesting technical solution of the construction of the Anju irrigation system stands out. The Taedong and Chkhonchkhon Rivers, between which lies Yel'tusamchkhonni Valley, serve as the water sources

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[170] Spurr, Russell. *Enter the Dragon: China's Undeclared War against the U.S. in Korea, 1950-51*. Newmarket Press, New York. 1988

[171] SEPTEMBER 15, 1960. JOURNAL OF SOVIET AMBASSADOR TO THE DPRK A.M. PUZANOV FOR 15-16 SEPTEMBER 1960. TOP SECRET. USSR MFA stamp: Copy Nº 3. FROM THE JOURNAL OF A. M. PUZANOV. 02153-gs. 10 October 1960. 30 September 1960. Nº 162. [handwritten in the left to G. Ye. Samsonov" and two other illegible names, one followed by "delo [file]] 035" and the other by "17 October 1960"]

> feeding this system. The unmanned water intake on the Taedong River, which lets 33 m of water a second through, is the head unit in the system. The waters of the Taedong River enter the Yenpkhun Reservoir from the water intake, passing by gravity through a four-kilometer tunnel.
>
> This reservoir is described by the following dimensions: the area of the water level is 1,595 jeongbo; the height of the embankment is 33.5 km; the length of the embankment is 245 m; the width of the reservoir varies from 0.5 to 2.5 km, and the length is up to 10 km; the average width is 8-12 meters, and in individual spots, up to 20-25 meters. The usable volume of the reservoir is about 154,000,000 m.
>
> The water also goes from the Yenpkhun Reservoir into the main channel via gravity. In the event the water in the reservoir is insufficient and it cannot go into the main channel via gravity the necessary amount of water for irrigation is taken from the Chkhonchkhon River with the aid of the Kymson water-pumping station at which eight Soviet pumps have been installed capable of passing up to 10 tons of water a second from a height of up to 14.7 meters. The water goes directly into the main channel.[172]

There was obviously a lot about the irrigation system that the Soviets did not know, even though they provided some financial and engineering support. Maybe they were only allowed to see what had been done as of 1954.

In the years immediately after the Korean War, China, the USSR and the East Bloc would grant North Korea foreign aid. East Germany would plan and rebuild the North Korean city of Hamhung. Czechoslovakia would provide aid in rebuilding and electrifying North Korea's war-torn rail roads; the Czechs also built underground munitions factories.[173] Moscow would provide additional financial aid and assistance, as would China. In Kim's mind all of this would eventually be channeled into the acquisition of a nuclear weapons capability. Power stations? Were rebuilt to support this eventual program. East German aid in building a new concrete plant? Well, concrete was needed in building reactors and uranium enrichment facilities. Everything achieved by the post-Korean War Stalinist state was suborned to Kim's ultimate goal, that of acquiring an atomic bomb.

Ambivalence Among Friends:
During the Cold War Kim Il-sung was often seen as waffling between an alliance with China, or an alliance with the Soviet Union. Despite the coverage provided by the Soviet nuclear umbrella, Kim wanted his own bomb, his own delivery systems. Those who wrote otherwise underestimated the Great Leader. There was never any great North Korean shift away from the protection of the Soviet Union, Kim always wanted the bomb.

Throughout the Cold War Kim Il-sung had an on again, off again relationship with the various countries that formed the East Bloc and the Warsaw Pact. High- or low-tide, North Korean relationships with these countries were always peppered with questions about advanced technologies leading to, or assistance in acquiring a nuclear weapon.[174] Kim asked the Soviet Union for assistance in acquiring nuclear weapons; North Korean scientists studied at Russia's Joint Institute for Nuclear Research in Dubna, his diplomats pressed the issue with Hungary, East Germany, Poland and Yugoslavia.

Despite the public need for the appearance of worldwide communist solidarity, privately, Kim Il-sung always wanted the bomb. Few theories of nuclear proliferation, if any, gave North Korea any chance of producing such a weapon. Theorists however, did not plan on the reality of a Kim Il-sung.

Few people in world history have been as enamored with an issue as to put aside all other earthly concerns in achieving their goal as was North Korea's Kim Il Sung. Lenin, Hitler, Stalin, Mao and Cambodia's Pol Pot come to mind, but even among those, some faltered along the way. Note Lenin, his post-Bolshevik revolution and his flirtation with a relaxation of rules against capitalism as a method of stabilizing Soviet Russia. Rumored throughout

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[172] SEPTEMBER 15, 1960. JOURNAL OF SOVIET AMBASSADOR TO THE DPRK A.M. PUZANOV FOR 15-16 SEPTEMBER 1960. TOP SECRET. USSR MFA stamp: Copy Nº 3. FROM THE JOURNAL OF A. M. PUZANOV. 02153-gs. 10 October 1960. 30 September 1960. Nº 162. [handwritten in the left to G. Ye. Samsonov" and two other illegible names, one followed by "delo [file]] 035" and the other by "17 October 1960"]

[173] Becker, Jasper. Rogue Regime. *Kim Jong il and the Looming Threat of North Korea.* Oxford University Press. 2005.

[174] Szalontai,Balazs and Sergey Radchenko. *North Korea's Efforts to Acquire Nuclear Technology and Nuclear Weapons: Evidence from Russian and Hungarian Archives*. Introduction by James F. Person. History and Public Policy Program. Woodrow Wilson International Center for Scholars. August 2006. https://www.wilsoncenter.org/sites/default/files/WP53_web_final1.pdf

the 1980s to be allied with Pakistan's Zulfikar Ali Bhutto, North Korea was – first and foremost – always after the bomb.

Water flow into the reservoir was gauged at 8 tons per second. The channel ran from a tributary, part of the Taedong watershed, of a portion of the northern Taedong River. The dam actually walled off an entire valley. The reservoir, once filled, would have a circumference of 20 kilometers, and would be, in places, 100 meters deep.

Sometime after the reservoir's dam was completed and filled, most likely in 1956, a body of water in North Korea was renamed, the Yongpung Reservoir. Sources indicate that the lake was built in 1956, the dam however was completed only a few years earlier, the reservoir had simply filled to capacity that year. On 23 September 1963, Chairman of the People's Republic of China and Vice-Chairman of the Central Committee of the Chinese Communist Party, Liu Shao-chi would go boating on the reservoir with North Korean President Choe Yong-gun.[175] Liu Shao-chi would note that the reservoir supported the largest irrigation project in Korea. [176] The reservoir dam began in 1946 at Unhung-ni, had become the Yongpung Reservoir. Such scenic beauty, where once men had died, could never remain pristine.

Of Country Homes and Recoil:
In October 1966, the largest among all of Kim Ii-sung's chalets was completed on the shores of Yongpung Reservoir. The lodge enclosed an area of about 300,000 square meters. The chalet consisted of one building. Ten additional houses for security and supporting facilities completed the home. Kim Il-sung usually visited Yongpung in the spring. The reservoir had become well-known for its lakeside fishing, a by-product of its clean, cold water. Nicolae Ceausescu would visit the lake in May 1978. [177] The Great Leader Kim Il-sung was with him. [178]

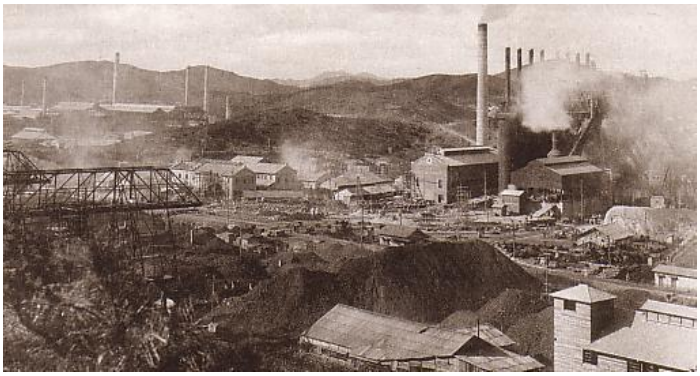
Development of a private hunting area for Kim Il-sung and Kim Jong-il began in 1978, and was completed in 1984. This was most likely the cover story given for ongoing aboveground construction projects several miles west of the main chalet which supported the two primary uranium enrichment efforts and the uranium hexafluoride storage site. However, the story might have worked had it not been for the installation's most glaring signatures or characteristics, its access to vast amounts of constant, stable, redundant sources of electrical power.

Keep in mind that, while there are most likely any number of other underground centrifuge halls and uranium hexafluoride storage sites, due to the imitations of North Korea's overall electric power production capacity, in the end, there could be only one EMIS facility. The villa was remodeled and modernized in 1979.

As the villa aged, and North Korea's uranium enrichment program matured, the deep interest shown the chalet in its early years also waned. In time, the country home was recast as a Korean Workers Party (KWP) Leadership Retreat and Chalet. Its visitors now included favored members of the Central Committee and the National Defense Council, as it well should: Though the earliest years of North Korea's uranium enrichment program were highly sensitive and only discussed among a few of the country's leadership, as the program succeeded, more access to the restricted site was granted, the villa now housed more transient visitors.: Tourists to the uranium wonderworld. On 21 May 2017 the reservoir served as the backdrop for the launch of a ground-to-ground Pukguksong-2 missile. [179]

[175] Shui, Wai. Chairman Liu Shao-chi in Korea. Sino-Korean Friendship. Peking Review, No. 39. 27 September 1963.
[176] Shui, Wai. Chairman Liu Shao-chi in Korea. Sino-Korean Friendship. Peking Review, No. 39. 27 September 1963.
[177] CEAUSESCU VISITS SCENIC SPOT. Pyongyang NODONG SINMUN (in Korean). 22 May 78
[178] CEAUSESCU VISITS SCENIC SPOT. Pyongyang NODONG SINMUN (in Korean). 22 May 78
[179] N. Korea missile launch site. Yonhap News Agency. 24 May 2017. https://en.yna.co.kr/view/PYH20170524063300341

As 1946 proceeded timber was mined at Yangdok, Kanggye and Musan. [180] Cement was brought into the area from the former Japanese cement plants at Sungho-ri and Haeju. [181] Iron was hauled north across the country from the former Mitsubishi Iron works at Kyomipo and east from Chongjin. Machinery was obtained through barter trade, a favorite North Korean trade mechanism, through Manchuria. [182] Machinery known to have been sent in from Manchuria included electrical appliances, pump and trolley parts. [183] It is not yet known to the satisfaction of this researcher, but it is likely that the machinery imported from Manchuria into the underground facilities associated with this water project, were obtained from the former Japanese Uranium Mining Project in Manchuria, which was part of the Japanese atomic energy and weapons program of WWII. [184] Manchuria no longer needed the equipment. When the Chinese communists took control of the mainland, the Great Helmsman, Chairman Mao had no interest in atomic weapons. Mao would eventually change his thinking on the value of such weapons in the mid-1950s but, by that time, no one in China had the courage to explain to the Great Helmsman what Japan had accomplished in China, Korea and Manchuria during WWII, especially how the equipment left behind by the Japanese in a now unified China, all wound up in a North Korea under Kim Il-sung.



The amount of materials pouring into the construction site was staggering for a North Korea reported to be economically devasted by the loss of Japanese support, and the imposition of communism by the Soviet Red Army in August 1945.

Once underway, the amount of materials arriving at the site from Sinanju itself equaled 20 carloads daily; 15 cars of cement, 3 cars of wood and two carloads of machine parts. Kaechon sent ten cement carloads per day, every day. Yongwon-ni, three carloads. Sukchon 2 carloads. [185] Altogether about 30 carloads construction material per day arrived at the site each and every day, [186] and this was just a few months after the end of WWII. Construction went on for years. According to the plan put forth by the North Korean Planning Commission (NPC), “the work shall be completed even if it takes half of the cement and timber produced in North Korea to finish the project.” [187] The NPC was serious, and the work was moving forward. Was it simply just a water irrigation project? A country on a wartime footing to complete a single irrigation project that once complete, would only feed the nation of 9.1 million people for a total of two months as of 1949. In 1978, despite the project’s ability to provide water to the area it

[180] Irrigation Works, Pyongan Namdo. KMAG (Korea Military Advisory Group) Liaison Office. 4302. 0300. North Korea. TB 2582 4671. T. I, G-2, Headquarters, Far East Command. Confidential Informant. 10 December 1949. Bibliographic ID (link to National Diet Library Online) digidepo_3540683 pdf-Anju

[181] Irrigation Works, Pyongan Namdo. KMAG (Korea Military Advisory Group) Liaison Office. 4302. 0300. North Korea. TB 2582 4671. T. I, G-2, Headquarters, Far East Command. Confidential Informant. 10 December 1949. Bibliographic ID (link to National Diet Library Online) digidepo_3540683 pdf-Anju

[182] Irrigation Works, Pyongan Namdo. KMAG (Korea Military Advisory Group) Liaison Office. 4302. 0300. North Korea. TB 2582 4671. T. I, G-2, Headquarters, Far East Command. Confidential Informant. 10 December 1949. Bibliographic ID (link to National Diet Library Online) digidepo_3540683 pdf-Anju

[183] Irrigation Works, Pyongan Namdo. KMAG (Korea Military Advisory Group) Liaison Office. 4302. 0300. North Korea. TB 2582 4671. T. I, G-2, Headquarters, Far East Command. Confidential Informant. 10 December 1949. Bibliographic ID (link to National Diet Library Online) digidepo_3540683 pdf-Anju

[184] Memorandum for Record. Nr 646. Rare Element Minerals in the Haicheng District, Liaoning Province, Manchuria. General Headquarters. Supreme Commander for the Allied Powers. Natural Resources Section. 8 October 1949. Record Group 331. Stack Area 290. Row 24 Compartment 2. Shelf 1. Entry 224. Box 2. The US National Archives and Records Administration, 8601 Adelphi Road, College Park, MD

[185] Irrigation Works, Pyongan Namdo. KMAG (Korea Military Advisory Group) Liaison Office. 4302. 0300. North Korea. TB 2582 4671. T. I, G-2, Headquarters, Far East Command. Confidential Informant. 10 December 1949. Bibliographic ID (link to National Diet Library Online) digidepo_3540683 pdf-Anju

[186] Irrigation Works, Pyongan Namdo. KMAG (Korea Military Advisory Group) Liaison Office. 4302. 0300. North Korea. TB 2582 4671. T. I, G-2, Headquarters, Far East Command. Confidential Informant. 10 December 1949. Bibliographic ID (link to National Diet Library Online) digidepo_3540683 pdf-Anju

[187] Irrigation Works, Pyongan Namdo. KMAG (Korea Military Advisory Group) Liaison Office. 4302. 0300. North Korea. TB 2582 4671. T. I, G-2, Headquarters, Far East Command. Confidential Informant. 10 December 1949. Bibliographic ID (link to National Diet Library Online) digidepo_3540683 pdf-Anju

supported in abundance, a suggestion to irrigate the Och'on area by cutting a tunnel to the Pyongwon (Yongpung) Reservoir and the Kiyang Irrigation works was – denied. [188]

All trucks, whether privately owned, assigned to a government office, a political party, or social organization in Pyongan Namdo or Pyongan Pukto were mobilized to support the project for three months each year to transport materials and other necessary items. [189] Most of the used trucks appear to have been leftover Japanese vehicles, a little less-than one-third were US. The US trucks probably came into Korea with the Soviet Red Army during Operation August Storm, the Soviet Invasion of Manchuria. During the last quarter of 1949, 520 trucks were mobilized to support the project. [190] Apparently, these trucks were originally some form of military surplus considered economic ais. All trucks used ran on gasoline, none were diesels. [191] All this was accomplished to complete to the project in a country that lacked an indigenous oil industry, one that would be starved for energy from about 1980 through the present day. How was this accomplished? Who paid the bills? Why? As of 10 October 1949, approximately half the project was done. [192]

Dubna:

On 5 February 1955, the Soviet Union and North Korea signed a five-year agreement on science and technology

cooperation, providing for the exchange of technical experiences and data, transfer of technical documentation, exchange of technical specialists, and other forms of technical assistance in all fields of the people's economy, including "joint nuclear research." [193] In June 1955, the DPRK was invited to send six representatives of the DPRK's Academy of Sciences to participate in the Eastern European scientific conference on the peaceful uses of nuclear energy. [194] There was, and never has been anything peaceful about North Korea's nuclear weapons program. In early 1956, North Korea was invited to become one of the founding member-states of the United Institute for Nuclear Research (UINR) opened in the Soviet town of Dubna on 26 March 1956. [195]

Signing the inter-governmental agreement on the establishment of the UINR and its charter in February 1956, Pyongyang would send more than 250 nuclear scientists and specialists to Dubna over the next four decades. Eighty percent of the DPRK representatives worked in various areas of experimental research at the Laboratory of Nuclear Problems, Laboratory of Nuclear Reactions, and Laboratory of Neutron Physics, whereas 20 percent of them worked on theoretical problems of nuclear research. The number of the DPRK nuclear scientists and specialists working at the UINR at a time varied from the maximum of sixteen in 1992 to the minimum of three in 1997. [196] Overall, North Korea's

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[188] On the Wide-Scale Reclamation of Tidal Flats and Their Cultivation. Speech at a Consultative Meeting of Agricultural Officials. 3 April 1978. Irrigation contained in Kim Il Sung. Works. Volume 33. January – December 1978. Foreign Languages Publishing House. Pyongyang, Korea. 1988

[189] Irrigation Works, Pyongan Namdo. KMAG (Korea Military Advisory Group) Liaison Office. 4302. 0300. North Korea. TB 2582 4671. T. I, G-2, Headquarters, Far East Command. Confidential Informant. 10 December 1949. Bibliographic ID (link to National Diet Library Online) digidepo_3540683 pdf-Anju

[190] Irrigation Works, Pyongan Namdo. KMAG (Korea Military Advisory Group) Liaison Office. 4302. 0300. North Korea. TB 2582 4671. T. I, G-2, Headquarters, Far East Command. Confidential Informant. 10 December 1949. Bibliographic ID (link to National Diet Library Online) digidepo_3540683 pdf-Anju

[191] Irrigation Works, Pyongan Namdo. KMAG (Korea Military Advisory Group) Liaison Office. 4302. 0300. North Korea. TB 2582 4671. T. I, G-2, Headquarters, Far East Command. Confidential Informant. 10 December 1949. Bibliographic ID (link to National Diet Library Online) digidepo_3540683 pdf-Anju

[192] Irrigation Works, Pyongan Namdo. KMAG (Korea Military Advisory Group) Liaison Office. 4302. 0300. North Korea. TB 2582 4671. T. I, G-2, Headquarters, Far East Command. Confidential Informant. 10 December 1949. Bibliographic ID (link to National Diet Library Online) digidepo_3540683 pdf-Anju

[193] *Otnosheniya Sovetskogo Soyuza s Narodnoy Koreyey, 1945-1980. Dokumenty imaterialy* (Relations of the Soviet Union and the People's Korea, 1945-1980. Documents and Materials, Moscow, 1981

[194] Mazaar, Michael J. *North Korea and the* Bomb. New York. St. Martin's Press, 1995

[195] Zhebin, Alexander, Political History of Soviet-North Korean Nuclear Cooperation, in eds. James Clay Moltz and Alexandre Mansourov, *The North Korean Nuclear Program: Security, Strategy, and New Perspectives from* Russia. Routledge. New York. 2000

[196] Mansourov, Alexandre. Soviet Occupation and Early Traces of North Korea's Nuclear Activities. North Korea's Road to the Atomic Bomb. International Journal of Korean Unification Studies, Vol. 13, No. 1, 2004.

progress was slow, but it was progress. Kim Il-sung would not let the opportunity created in the foundation of the UINR be a sleeping dog for long.

In a report sent by V. I. Ivanov, the Soviet Ambassador to North Korea, Ivanov wrote: "I visited Kim Il Sung and delivered a memo to him in accordance with your Instruction No. 35. In conversation Kim Il Sung said that Korean scientists have long raised the question to us of getting an opportunity to work in the field of nuclear research, to which we told them that when the opportunity and need arise such conditions will be created, and the USSR will not forget us in this." [197] It was part of Kim Il-sung's constant pressure program against the Soviet Union and its East Bloc allies for information on nuclear weapons. It was unabashed, lacked subtlety, and was continuous.

North Korean graduates of the UINR, included 25 Masters of Science and two Doctors of Science, went on to occupy the top-level positions in the DPRK's national nuclear research program. They were placed in charge of the Scientific Research Center on Atomic Energy in Nyongbyon (Dr. Paek Kwan-oh), the Nyongbyon Institute of Nuclear Physics (established in 1964), the Nyongbyon Institute of Atomic Energy (established in January 1962, a well-known North Korean chemist Dr. Yi Sung-ki was named its first Director), the Pakch'on branch of the Institute of Atomic Energy (established in 1962), the Nyongbyon Radiochemistry Laboratory (Dr. Li Sang Gun), the Department of Nuclear Physics at the Kim Il-sung University (since 1973) and Departments of Nuclear and Electrical Engineering, of Nuclear Fuel Engineering, and of Atomic Reactor Engineering at the Kimch'aek Polytechnic University (since 1973), the Kim Il-sung High Physics Academy in Ryanggang Province (since 1963 also known as the Nuclear Engineering Department at the National Defense College in Hyesan, Ryanggang), P'yongsong Institute of Science (a course in nuclear physics since 1963), and Nanam Branch of the Institute of Atomic Energy in Nanam-kuyok in Ch'ongjin (since 1965). [198] Graduates who made their way to the Sinanju Munitions Plant were never revealed but there had to be some. There were also Japanese-trained scientists present who had worked on the WWII Japanese bomb program

Growing the Bureaucracy:
During its existence, the Soviet Union trained also trained more than 300 North Korean nuclear specialists at various Soviet institutions of higher education such as the Moscow Engineering Physics Institute (MEPHI), the Bauman Higher Technical School (Bauman VTU), the Moscow Energy Institute (MEI), and others. [199] These people constituted the backbone of the DPRK's nuclear establishment and became one of the driving forces in the evolution of the national nuclear program, especially in various joint collaborative projects between their respective institutions and the UINR in a number of key areas of theoretical and experimental nuclear research. The water project would require a large management scheme. Government projects always required a large number of hooded-eye bureaucrats.

21 different departments and sections were established to manage the project. [200] The overall chief of staff was a Korean Communist Party-member and was noted by defectors as a "extreme leftist." [201] Most engineers were electrical, engineering school or university graduates. Several were noted as homegrown engineers with no formal education but probably a lot of rough years spent learning their trade – and they were good at it. Most were members of the Korean Communist Party.

350 technicians were required to manage daily operations. Another 850 laborers and skilled workers rounded out the workforce. 600 office workers and low-level administrators were required to keep the project moving. The main office would be located in a former Japanese monopoly building in the Wonchin-ni district of Sinanju, 500 meters

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[197] SOVIET EMBASSY IN THE DPRK JOURNAL of V. I. Ivanov, Soviet Ambassador in the DPRK for the period from 20 to 30 January 1956 Pyongyang January 20, 1956. Journal of Soviet Ambassador to the DPRK V. I. Ivanov for 20 January 1956. I. Shcherbakov 29 March 1956. History and Public Policy Program. Woodrow Wilson International Center for Scholars. https://digitalarchive.wilsoncenter.org/document/120790.pdf?v=1ba4c684844b64bde4de7ebf2ab7dfa5

[198] *Obyedinenniy institut yadernykh* issledovaniy. United Institute for Nuclear Research. Dubna. 1994

[199] Georgy Kaurov, A Technical History of Soviet-North Korean Nuclear Relations, in eds., Clay Moltz and Alexandre Mansourov, *The North Korean Nuclear Program: Security, Strategy, and New Perspectives from* Russia. Routledge. New York. 2000

[200] Irrigation Works, Pyongan Namdo. KMAG (Korea Military Advisory Group) Liaison Office. 4302. 0300. North Korea. TB 2582 4671. T. I, G-2, Headquarters, Far East Command. Confidential Informant. 10 December 1949. Bibliographic ID (link to National Diet Library Online) digidepo_3540683 pdf-Anju

[201] Irrigation Works, Pyongan Namdo. KMAG (Korea Military Advisory Group) Liaison Office. 4302. 0300. North Korea. TB 2582 4671. T. I, G-2, Headquarters, Far East Command. Confidential Informant. 10 December 1949. Bibliographic ID (link to National Diet Library Online) digidepo_3540683 pdf-Anju

east of the Sinanju Rail Road Station. Day-to-day water distribution would be conducted by nine water management subdistrict offices. These would be located at Yongwon-ni in Kaechon-gun; Unhung-ni, Hwayang-ni, Taekyo-ni, Yongyon-ni, Ipsok-ni in Anju-gun and Unsori, Songchong-ni and Hanchon-ni in Pyongwon-gun. Two, possibly three of these water management offices, would serve the eventual uranium works directly. Each office maintained a number of pumps that supported water distribution. These ranged in size from 50 to 500 horsepower in size. [202] A total of 43 pumps were installed. Pump stations ranged in size from one pump, to a total of 11. [203]

In a speech delivered at the Second Meeting of Party Activists of the General Staff of the Supreme Headquarters of the Korean People's Army Kim argued: "Those who are not armed with Marxism-Leninism do not think as we do. They only know the mightiness of atomic or hydrogen bombs; they do not understand that Marxist-Leninist ideology, the guiding compass of our action, is an ever-victorious weapon stronger than any bomb." [204] For someone who abhorred atomic weapons, he talked a lot about a hydrogen bomb that was not tested until nearly a year later on 1 November 1952. Three short years later, in 1955, Kim was proposing nuclear research projects in North Korea. [205]

Though the hydrogen bomb had been heatedly discussed in the world press, Kim's comments showed that he was aware of the weapon and its potentials. In a report, a letter to his countrymen celebrating the sixth anniversary of the August 15 Liberation, the end of WWII, the collapse of Japan and the entry of the Red Army into Korea, Kim publicly stood with the Soviet Union in its revulsion of nuclear weapons. [206] The Soviet Union's repugnance of nuclear devices would at its height, number some 45,000 weapons. [207]

In an April 1955 speech, the Great Leader drew particular attention to the Anju irrigation project that envisaged the excavation of hundreds of kilometers of waterways including tributaries. [208] The project was largely complete, its reservoir nearly full, now all that was needed was time; time to study technology, develop friendly relations, accumulate information, make decisions, harass allies for information and assistance. Large-scale construction apparently ended in 1956. It was a banner year, Khrushchev had denounced Kim's mentor, Joseph Stalin. In the months that followed, a de-Stalinization campaign swept the socialist world. Kim's desire for a solely North Korean nuclear capability solidified. The irrigation project remained however, still under construction in April 1957. [209]

Had anyone paid attention – and had Kim Il-sung bragged more – they would have noticed that construction on the project would never end, and in certain areas, such as at the Sinanju Munitions Plant, was probably open-ended.

[202] Irrigation Works, Pyongan Namdo. KMAG (Korea Military Advisory Group) Liaison Office. 4302. 0300. North Korea. TB 2582 4671. T. I, G-2, Headquarters, Far East Command. Confidential Informant. 10 December 1949. Bibliographic ID (link to National Diet Library Online) digidepo_3540683 pdf-Anju

[203] Irrigation Works, Pyongan Namdo. KMAG (Korea Military Advisory Group) Liaison Office. 4302. 0300. North Korea. TB 2582 4671. T. I, G-2, Headquarters, Far East Command. Confidential Informant. 10 December 1949. Bibliographic ID (link to National Diet Library Online) digidepo_3540683 pdf-Anju

[204] On Strengthening Party Life in the People's Army. Speech Delivered at the Second Meeting of Party Activists of the General Staff of the Supreme Headquarters of the Korean People's Army. 18 March 1951 contained in Kim Il Sung. Works. Volume 6. June 1950 – December 1951. Foreign Languages Publishing House. Pyongyang, Korea. 1981

[205] Talk with the Faculty Members and Students of Kim Il Sung University. Research at Colleges and Universities. 1 July 1955. contained in Kim Il Sung. Works. Volume 9. July 1954 – December 1955. Foreign Languages Publishing House. Pyongyang, Korea. 1982

[206] Report at the Pyongyang meeting to celebrate the sixth anniversary of the August 15 liberation. 14 August 1951 contained in Kim Il Sung. Volume 6. June 1950 – December 1951. Foreign Languages Publishing House. Pyongyang, Korea. 1981

[207] Robert S. Norris and Hans M. Kristensen, "Global nuclear stockpiles, 1945-2006," Bulletin of the Atomic Scientists 62, no. 4. July/August 2006

[208] Josephson, Paul R. Would Trotsky Wear a Bluetooth? Technological Utopianism under Socialism, 1917–1989. The Johns Hopkins University Press. Baltimore. 2010

[209] Economic Intelligence Report. The Construction Industry of North Korea 1954-56. Central Intelligence Agency. Office of Research and Reports. CIA/RR 105. 14 October 1957

Even while the Korean War was ongoing however, Kim maintained a poker face concerning atomic weapons. Under the Soviet nuclear umbrella and in cahoots with his communist allies Kim was opposed to atomic weapons.

Between 1956 and 1960, the number of scientific institutes in North Korea multiplied by 2.8 times. [210] Many of North Korea's best scientists had a natural inclination to the subject and never received much formal education; they learned their trade on-the-job over time, experience was highly valued. Many had formerly worked as technicians under the Japanese in various industries across the peninsula during the Japanese Occupation of Korea. Through science Kim sought to improve North Korea's economy and therefore improve the lives of all Koreans…sorta. National security and regime survival were however, much more important. Under the Soviet nuclear umbrella of the 1950s and 1960s, North Korea was safe from a US nuclear attack. Kim knew that, to build an atomic bomb, then nuclear and finally thermo-nuclear weapons that North Korean science and technology would have to improve, drastically, but also that it would take time. That was the only sure resource that Kim had. Time.

The Greater Leader:

In May 1961, South Korean General Park Chung-hee a led military takeover in Seoul. Though North Korea had always maintained a bellicose foreign policy toward South Korea, Park was a man who would not be intimidated, would not be cowed. Park would also eventually seek a nuclear weapons capability. In the early 1970s, as its nuclear power program grew, President Park Chung-hee began to investigate possibilities of nuclear weapons. Park was behind the power curve on the Korean Peninsula and may have known.

By late 1961, possibly due to the actions of Park Chung-hee in South Korea, Kim had apparently brushed up on his nuclear physics, suggesting the use of radioisotopes and radiation through far ranging programs. [211] He wanted study of supersonic waves and high-frequency electronics, sciences applicable to the achievement of a nuclear weapons capability. [212] Kim Il-sung was seeking an improvement in fundamental sciences; mathematics, physics, chemistry and biology. Kim's term was the exact same term used by Japan's Nishina Yoshio in his role as Chief, Theoretical Physics, during Japan's WWII-era atomic energy and weapons research program. [213] Fundamental, basic sciences. Kim promoted the importation of scientific books and magazines, the study of foreign languages to allow interpreting these into Korean, and the study of student abroad. [214]

At the North Korea's Fourth Party Congress meeting the same day as Kim Il-sung pushed advance in science, North Korean nuclear scientists and engineers were given the task of "advancing research in the use of atomic energy for peaceful purposes, widely utilizing radioactive isotopes and rays in industry, agriculture, and other spheres, and manufacturing all necessary isotopes and measurement instruments." [215] In his speech at the Fourth Party Congress, Professor Do Sang-rok, the so called "father of the North Korean nuclear program," urged the nation to "support nuclear research and the training of specialists in the field of

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[210] Development of Science and Culture. I, Basic Tasks of the Seven-Year Plan. II. Far Reaching Prospects. Report to the Work of the Central Committee to the Fourth Congress of the Workers' Party of Korea. 11 September. 1961. contained in Kim Il Sung. Works. Volume 15. January – December 1961. Foreign Languages Publishing House. Pyongyang, Korea. 1983

[211] Development of Science and Culture. I, Basic Tasks of the Seven-Year Plan. II. Far Reaching Prospects. Report to the Work of the Central Committee to the Fourth Congress of the Workers' Party of Korea. 11 September. 1961. contained in Kim Il Sung. Works. Volume 15. January – December 1961. Foreign Languages Publishing House. Pyongyang, Korea. 1983

[212] Development of Science and Culture. I, Basic Tasks of the Seven-Year Plan. II. Far Reaching Prospects. Report to the Work of the Central Committee to the Fourth Congress of the Workers' Party of Korea. 11 September. 1961. contained in Kim Il Sung. Works. Volume 15. January – December 1961. Foreign Languages Publishing House. Pyongyang, Korea. 1983

[213] Development of Science and Culture. I, Basic Tasks of the Seven-Year Plan. II. Far Reaching Prospects. Report to the Work of the Central Committee to the Fourth Congress of the Workers' Party of Korea. 11 September. 1961. contained in Kim Il Sung. Works. Volume 15. January – December 1961. Foreign Languages Publishing House. Pyongyang, Korea. 1983

[214] Development of Science and Culture. I, Basic Tasks of the Seven-Year Plan. II. Far Reaching Prospects. Report to the Work of the Central Committee to the Fourth Congress of the Workers' Party of Korea. 11 September. 1961. contained in Kim Il Sung. Works. Volume 15. January – December 1961. Foreign Languages Publishing House. Pyongyang, Korea. 1983

[215] Svetlana G. Nam, *Education and Science in the DPRK under the Conditions of Scientific-Technical Revolution*, Nauka Publishing House: Institute of Oriental Studies. The USSR Academy of Sciences, Moscow. 1975

atomic energy." [216] Continued progress in the nuclear development program was seen as a necessary *juche*-style addition to freshly inked allied guarantees North Korean regime survival and a major self-reliant component of the DPRK's national security strategy. Geopolitical alliances were seen as transient and unreliable, whereas a self-reliant nuclear deterrent was hoped to be permanent and absolutely dependable. [217] Publicly, North Korea would always promote its program as a pursuit of peaceful nuclear power. Like the Japanese program of WWII, it was never more than a search for nuclear weapon. There was never anything peaceful about it.

Within two months of the South Korean military coup, North Korea signed a Treaty of Friendship, Cooperation and Mutual Assistance with the Soviet Union. Within days, Pyongyang signed a similar agreement with Beijing. With the inclusion of mutual defense clauses that committed the parties to aid one another if attacked, the agreements provided North Korea with a greater sense of security. [218]

The treaty with Moscow however did not instill in Kim Il Sung a sense of confidence regarding Moscow's security commitment to North Korea. The Korean leadership under Kim Il-sung harbored deep suspicions of the Soviet Union in the wake of Khrushchev's denouncement of the Stalin empire. Kim had been trying to get such an agreement from the Soviets for over two years. North Korea's Ambassador to Moscow Ri Sin-Pal had also been busy.

Meeting with Andrei Gromyko in April 1958 Ri Sin-pal reported that North Korea was proposing to develop a plan of scientific research work to organize the production of atomic energy for peaceful purposes. However, the DPRK did not have either experience or specialists in this field. The Korean government understood that it was in no condition to begin such work without Soviet aid. In connection with this, the North Korean government was turning to the government of the Soviet Union with a request for assistance in preparing and drawing up a plan of scientific research work to organize the production of atomic energy for peaceful purposes. In particular, the Korean side was asking the Soviet government to receive a DPRK delegation concerning this issue, and consult about issues relating to the production of atomic energy for peaceful purposes. [219]

A few months after the withdrawal in October 1958 of the Chinese People's Volunteer Army (which had entered North Korea in late 1950 to fight the Americans), Kim Il Sung traveled to Moscow in late January 1959 to attend the CPSU XXI Congress. During this trip, Kim proposed the signing of a mutual cooperation treaty with the Soviet Union, Pyongyang's chief supplier of advanced weaponry and machinery. Though Khrushchev acceded to his request, and agreed to visit Pyongyang later that year to sign the agreement, for over two years, the Kremlin leader found reasons to postpone his trip. Khrushchev finally signed the agreement in July 1961 when Kim again traveled to Moscow. [220]

Cynicism among Allies:
The North Korean leadership believed that their suspicions of Moscow's unreliability were confirmed in October 1962 when Khrushchev "betrayed Cuba at the time of the Caribbean crisis [the Cuban Missile Crisis]." [221] What the North Koreans viewed as Soviet capitulation in the face of pressure from the Kennedy Administration demonstrated that Khrushchev was more concerned about peaceful coexistence, and being, in the words of Kim Il Sung, "buddy-buddy with Eisenhower and Kennedy" than he was in aiding smaller socialist countries that, in the eyes of the North Koreans, were vulnerable to being picked off, one by one, by the United States. During a tense exchange in January 1965, North Korean Vice Premier Kim Il explained to Soviet Premier Aleksei Kosygin that as a result of the Cuban

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[216] ROK Ministry of Unification, Pukhan Kaeyo 2000. Ministry of Unification. Seoul. December 1999

[217] Mansourov, Alexandre. Soviet Occupation and Early Traces of North Korea's Nuclear Activities. North Korea's Road to the Atomic Bomb. International Journal of Korean Unification Studies. Vol. 13, No. 1, 2004

[218] THE CUBAN MISSILE CRISIS AND THE ORIGINS OF NORTH KOREA'S POLICY OF SELF-RELIANCE IN NATIONAL DEFENSE. Introduction by James F. Person. History and Public Policy Program. Woodrow Wilson International Center for Scholars. www.wilsoncenter.org/nkidp

[219] Record of a Conversation with Ambassador Ri Sin-Pal of The Democratic People's Republic of Korea on 28 April 1958. From the Journal of Gromyko, Record of a Conversation with Ambassador Ri Sin-Pal of the Democratic People's Republic of Korea. 28 April 1958. USSR MFA Far East. History and Public Policy Program. Woodrow Wilson International Center for Scholars. https://digitalarchive.wilsoncenter.org/document/116019.pdf?v=676a0ca824e2825064bdd0175d9fbc73

[220] THE CUBAN MISSILE CRISIS AND THE ORIGINS OF NORTH KOREA'S POLICY OF SELF-RELIANCE IN NATIONAL DEFENSE. Introduction by James F. Person. Introduction by James F. Person. History and Public Policy Program. Woodrow Wilson International Center for Scholars. www.wilsoncenter.org/nkidp

[221] Embassy of Hungary in North Korea to the Hungarian Foreign Ministry, 8 January 1965, MOL, XIX-J-1-j Korea.1965. 73. Doboz. IV-100. 001819/1965. Report

Missile Crisis, the North Korean leadership felt that it "could not count that the Soviet government would keep the obligations related to the defense of Korea it assumed in the Treaty of Friendship, Cooperation and Mutual Assistance." [222]

In the wake of the Cuban Missile Crisis, however, North Korea publicly sided with the Chinese in the Sino-Soviet split, and expressed opposition to Khrushchev's purported revisionism, particularly his policy of peaceful coexistence with the United States. Both Pyongyang and Beijing advocated for a far more militant policy of anti-imperialist struggle. [223]

North Korea's mistrust of Moscow was reinforced when the Soviets did not grant a request from Pyongyang for military aid in December 1962. In the immediate wake of the Cuban Missile Crisis, on 1 November Kim Il Sung expressed his concern to Soviet Ambassador Vasily Moskovsky that the North's air and coastal defenses were in poor shape. Major cities, such as Pyongyang, Wonsan, Chongjin, and Hamheung [Hamhung], were poorly protected from air raids. He therefore, requested permission to send a delegation to Moscow to discuss military aid. Kim requested that the Soviet Union deliver – on credit – some 100 million rubles in military aid to North Korea. [224] Specifically, to enhance coastal defenses, he asked for submarines. For air defenses, Kim requested an unspecified number of MIG-21s and twelve surface-to-air missile batteries. [225]

In a 14 November conversation with Soviet Ambassador Moskovsky, Kim Il Sung played up the threat to North Korea, remarking "I know that [First Secretary Khrushchev and Second Secretary Frol Kozlov] are no less concerned than I about the defense of the Far Eastern forward post…it provides a convenient platform for the enemy's landing." [226] Yet, Deputy Premier Kim Gwanghyeop's 29 November to 5 December 1962 visit to Moscow ended in failure. Moscow would sell the weapons to Pyongyang, but not give them on credit. Without delay, the North Korea regime escalated its efforts to achieve self-reliance in national defense. [227] North Korea's strategy of keeping the country in a constant state of mobilization had drastic effects on the North Korean economy. The management of resources allows many things to get done, the concentration of resources allows only a few issues to move forward. Unknown to most, underneath the façade, North Korea had become a one-issue state. North Korea's First Seven-Year Plan, 1961-67, fell three years behind. It did not fail because its public goals were far too ambitious, it failed because its "black" programs, those hidden from view, sapped its resources. Its initial goals would not see success until 1970. Hitting the "learning curve," North Korea claimed to have fulfilled its next Six-Year Plan by the end of August 1975, a full year and four months ahead of schedule. However, its next Six-Year Plan did not start until 1977, two years overdue. The lives of the average North Korean would not begin to improve until the late 2000s and then only barely. Projects initiated in the 1950s were upgraded with new roofs, new paint and so on after about 2005.

One week later, the Fifth Plenum of the Fourth KWP, December 1962, the Central Committee formally adopted what it referred to as the equal emphasis policy, initially launched in the wake of the May 1961 military coup in South Korea, which called for simultaneous development of heavy industry and defense capabilities. The Plenum also declared Four Military Guidelines: to arm the entire population; to fortify the entire country; to train the entire army as a "cadre army;" and to modernize weaponry, doctrine, and tactics under the principle of self-reliance in national defense. Hungarian diplomats reported that by February 1963 "large-scale work [was] going on throughout the country; not only entrenchments but also air-raid shelters for the population [were] being built in the mountains."

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[222] Record of a conversation with the Soviet Ambassador in the DPRK Comrade V.P. Moskovsky about the negotiations between the Soviet delegation, led by the USSR Council of Ministers Chairman Kosygin, and the governing body of the Korean Workers Party. 16 February 1965. Czech Foreign Ministry Archive

[223] THE CUBAN MISSILE CRISIS AND THE ORIGINS OF NORTH KOREA'S POLICY OF SELF-RELIANCE IN NATIONAL DEFENSE. Introduction by James F. Person. Introduction by James F. Person. History and Public Policy Program. Woodrow Wilson International Center for Scholars. www.wilsoncenter.org/nkidp

[224] Memorandum of Conversation between Soviet Ambassador to North Korea Vasily Moskovsky and Kim Il Sung.
1 November 1962. AVPRF. Fond 0102. Opis 18. Papka 93. Delo 5. Listy

[225] Memorandum of Conversation between Soviet Ambassador to North Korea Vasily Moskovsky and Kim Il Sung.
14 November 1962. AVPRF, Fond 0102. Opis 18. Papka 93. Delo 5, Listy

[226] Memorandum of Conversation between Soviet Ambassador to North Korea Vasily Moskovsky and Kim Il Sung.
14 November 1962. AVPRF. Fond 0102, Opis 18. Papka 93. Delo 5. Listy

[227] The Cuban Missile Crisis and The Origins of North Korea's Policy Of Self-Reliance In National Defense. Introduction by James F. Person. Introduction by James F. Person. History and Public Policy Program. Woodrow Wilson International Center for Scholars. www.wilsoncenter.org/nkidp

[228] The construction of many of these had begun under the Japanese, to include those at Hamhung, Sinanju and Kanggye. I many cases these were just being built out, fitted out, completed. The comments of Karoly Fedler, deputy ambassador to North Korea were insightful.

"On 23 May […] we visited the museum in Pyongyang that was built to commemorate the 1950-53 Korean War. […] an interesting conversation occurred between me [István Garajszki] and the political officer who accompanied us. The latter declared that not even a hydrogen bomb could do damage to such fortifications that had been hollowed into rocks. Thereupon I remarked that the deeper caverns could indeed save those who stayed there in the moment of the explosion, but on the surface, everything would be destroyed, and thereafter for a long-time people could not leave the caverns because of the radioactive pollution. The officer replied that the people staying in the caverns would be provided with everything that they needed, and the Americans could not devastate the entire country anyway. Therefore „on the order of Comrade Kim Il Sung, we built a network of caverns of this type in the entire country." When I remarked that two or three hydrogen bombs would be sufficient to destroy an area the size of the DPRK, the officer became embarrassed, and declared "Comrade Kim Il Sung told us that we won the first war by means of our rock-caverns, and we would also win the second one with their help!" [emphasis in the original] Understandably, I dropped the subject after that." [229] North Korea's pressure campaign never ended.

In a conversation between Soviet Ambassador in North Korea Vasily Moskovsky and the German Ambassador in August 1963, the ambassador reported: "[I] received the GDR Ambassador at his request. [The ambassador] said that the Koreans, apparently on Chinese instructions, are asking whether they could obtain any kind of information about nuclear weapons and the atomic industry from German universities and research institutes. […]." [230] The North Koreans had obviously been pestering China for nuclear secrets and had been told "go ask daddy," the Soviet Union. North Korean inquiries continued.

In September 1963 the Soviet Ambassador in North Korea Vasily Moskovsky invited Soviet specialists' comrades Konstantinov V.M. and Syromyatnikov B.N., who were studying uranium ore in the DPRK, for a talk at the Embassy. The specialists told Moskovsky "that the Korean side insistently tries to obtain information about the deposits and quality of the uranium ore mined in the Soviet Union. But our comrades have been instructed on this account, and know how to evade answering such questions. Our specialists reported that the Korean uranium ore is not rich and is very scarce. The mining and processing of such ore will be extremely expensive for the Koreans. But from conversations with the Korean specialists they learned that the Koreans, despite all odds, want to develop the mining of uranium ore on a broad scale. In all probability, comrades said, uranium ore mined in the DPRK will be supplied to China, since in order to satisfy one's own internal needs for one's own atomic reactor, one needs a very minor amount of uranium ore." [231] That the North Korean uranium deposits were identified by the Soviet specialists were "not rich and is very scarce" is surprising. Today's media reports North Korean deposits as abundant. The Soviet specialist were there, on-site, suggesting the North Korea had actually imported ore stocks far earlier from other deposits in East Asia long before their program drew international attention. The imports not seen by the Soviet Specialists were probably Japanese stocks of radioactive ores spread throughout Southeast Asia and dated from WWII.

***Juche*:**

The fundamental objective of North Korea's scientists at that time was however, to support the basic needs of the country – exactly the problem faced by Japanese scientists after the collapse of Japan at the end of WWII. The Japanese success served as a model for the North Korean leadership. North Korea's leadership would emulate Japan's efforts closely, as closely as possible within the bounds of Marxist and Leninist thought, later overlaid with Pyongyang's new ideology, *juche* – self-reliance.

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[228] Report, Embassy of Hungary in North Korea to the Hungarian Foreign Ministry. 8 January 1965. MOL, XIX-J-1-j. Korea, 1965, 73. doboz, IV-100, 001819/1965

[229] May 27, 1963 Report, Embassy of Hungary in North Korea to the Hungarian Foreign Ministry. History and Public Policy Program. Woodrow Wilson International Center for Scholars https://digitalarchive.wilsoncenter.org/document/110606.pdf?v=4bd3e7db88e7bdaa2b3d5093c39ec8ec

[230] August 26, 1963 Conversation between Soviet Ambassador in North Korea Vasily Moskovsky and the German Ambassador. History and Public Policy Program. Woodrow Wilson International Center for Scholars https://digitalarchive.wilsoncenter.org/document/110608.pdf?v=8e1d1d7c14761837c23d5773137f4dc5

[231] September 27, 1963 Conversation between Soviet Ambassador in North Korea Vasily Moskovsky and Soviet Specialists in North Korea. History and Public Policy Program. Woodrow Wilson International Center for Scholars https://digitalarchive.wilsoncenter.org/document/110611.pdf?v=18bcbf707bcd88c9dfe503b1ee615ec6

Though credited to Kim Il-sung thought in the 1930s, *juche* actually did not appear as a Korean ideology until 1955, just as the Yongpung Reservoir and Anju Water Utilization Construction Works began to bear fruit. It is unknown but likely that the purposes of the Yongpung Reservoir and Anju Water Utilization Construction Works stimulated the development, or was the origin, of North Korea's *juche*. Japanese, Soviet or Korean, the project intrinsically bore within it, all the political principals that were to grow out of Kim Il-sung's state-sponsored *juche*. The ideology also appealed to Korean myths and historical reality. In the historical past, Korean self-sufficiency was the key to survival. Individually, by the family, kinship or clan, Koreans survived. Koreans always survived. During the Japanese Occupation of Korea, that concept of survival hardened – rock solid.

The Nyongbyon Nuclear Scientific Research Complex:

In the aftermath of the Sino-Soviet Split in 1960 the Soviet government dispatched thirty Soviet nuclear specialists led by the well-known Soviet nuclear scientist Vladislav Kotlov to assist the North Korea government in establishing the Nyongbyon Nuclear Scientific Research Complex, construction of which began in 1961, and was commissioned in 1965. The USSR supplied the required Soviet engineering blueprints, nuclear equipment, nuclear fuel, and contributed the bulk of the 500 million US dollars (in 1962 prices) required to finance the total start-up costs of the Nyongbyon core facilities. [232]

The Soviet-North Korean rift lasted from the fall of 1962 through the end of 1964. During this period, North Korea drew closer to the People's Republic of China than at any point in the history of Sino-DPRK relations. The fear of losing their freedom of action due to long term exclusive orientation toward the PRC eventually forced North Korean leaders to change their approach to developing international contacts with the USSR and European socialist countries. This change coincided with Khrushchev's involuntary departure, in October 1964, from the leadership of the Communist Party of the Soviet Union (CPSU) and USSR. [233] However, Kim Il Sung never fully trusted the Soviets Union again.

It wasn't until 1965, as the facilities at Nyongbyong came online that Kim Il-sung began to publicly ruminate about atomic energy research, the usual public cover for a nuclear weapons program. [234] Kim discussed the program in terms of machine engineering, electronics, semi-conductor technology and other applied sciences. Regarding atomic energy research he noted that there were many problems. He observed that North Korea had plenty of nuclear materials, which was probably a lie, but indicated that the country could not yet treat such materials industrially. The country could mine the materials, it could convert them to yellowcake, probably convert them to uranium hexafluoride but further progress required better technology. The reactor at Nyongbyon provided good experience and opened doors for North Korean scientists abroad when approaching countries that had an interest in a weapons program but, no reactor.

Interestingly, the construction of the Nyongbyon Nuclear Scientific Research Center was completed only after Khrushchev was deposed in October 1964, and a more conservative and pragmatic Brezhnev administration was installed in the Kremlin. "Regime change" in Moscow saved Kim Il Sung's nuclear dream and allowed Pyongyang to obtain its initial nuclear capabilities. [235] The aggravating international situation around the Korean peninsula amidst the raging Cold War in the mid-1960s, forced Moscow to place greater strategic value on North Korea and reinforced Moscow's earlier commitment to provide its North Korean communist ally with nuclear research capabilities. [236] In 1964, shortly after China conducted its first nuclear test, North Korea directly asked China to "share the nuclear secret." [237] Over the next decade and a half, North Korea continued unsuccessfully to press its

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[232] "Contract for the Construction of the Object 9559" (in Russian), State Committee on Atomic Energy. USSR Council of Ministers. Moscow. 1962

[233] THE CUBAN MISSILE CRISIS AND THE ORIGINS OF NORTH KOREA'S POLICY OF SELF-RELIANCE IN NATIONAL DEFENSE. Introduction by James F. Person. Introduction by James F. Person. History and Public Policy Program. Woodrow Wilson International Center for Scholars. www.wilsoncenter.org/nkidp

[234] 2. On Firmly Establishing Juche in Education and Scientific Research. On Improving Higher Education. Speech at the General Membership Meeting of the Party Organization of the Ministry of Higher Education. 23 February 1965. contained in Kim Il Sung. Works. Volume 19. January – October 1965. Foreign Languages Publishing House. Pyongyang, Korea. 1984

[235] Mansourov, Alexandre. Soviet Occupation and Early Traces of North Korea's Nuclear Activities. North Korea's Road to the Atomic Bomb. International Journal of Korean Unification Studies, Vol. 13, No. 1, 2004

[236] Mansourov, Alexandre. Soviet Occupation and Early Traces of North Korea's Nuclear Activities. North Korea's Road to the Atomic Bomb. International Journal of Korean Unification Studies, Vol. 13, No. 1, 2004

[237] Oberdorfer and Carlin. The Two Koreas; "North Korea: Denial of nuclear arms production." FBIS Trends. 9 August 1989 https://www.cia.gov/library/readingroom/docs/DOC_0000453457.pdf

Cold War allies for nuclear assistance, including East Germany, Czechoslovakia, and, again, from the Soviet Union and China.

Shortly after Khrushchev's fall from power, in fact that same month, Soviet Prime Minister, technocrat Kosygin paid an official visit to the North Korea. His assignment was to mend fences, giving a green light to the commissioning of the IRT-2000 nuclear research reactor in Nyongbyon only after he received assurances from top-level North Korean leaders that the purpose of the North Korea's nuclear program was, peaceful in nature. [238] After Kosygin's departure, Soviet nuclear specialists employed at Nyongbyon gradually transferred control over the key nuclear installations installed by the Soviet Union to their North Korean counterparts. By the end of 1965 all thirty Soviet technicians were gone. [239] So were North Korean promises that its nuclear program was peaceful in nature.

On 27 April 1965 two North Korean MiG-17s attacked a United States Air Force RB-47 Stratojet reconnaissance aircraft over the Sea of Japan, 80 km (50 mi) from the North Korean shore. The Stratojet was damaged, but managed to land at Yokota Air Base, Japan. On 19 January 1967 the ROK *Dangpo* (PCEC 56) (formerly the USS *Marfa* (PCE-842) was sunk by North Korean coastal artillery north of the maritime demarcation line off the east coast of Korea, 39 ROK sailors were killed. Tensions increased and other confrontations followed.

The Psychedelic Sixties:
Kim Il-sung once described the second half of the 1960s as "a period of grim ordeal in which very complex and difficult circumstances were created in our revolution and construction... Our spending on national defense was too heavy a burden for us in the light of the small size of the country and its population." [240] From1966 to 1969, a severe policy conflict and fierce power struggle erupted between military hardliners who advocated a radical defense build-up, total defense mobilization, and a militant policy towards the United States and ROK, and the so-called moderate group, who argued for the more proportionate economic development and continuation on a "peaceful road to socialism." [241] There would be no peaceful road to socialism.

That March, Kim Il-sung, Ri Jong-ok, O Jin-u [O Chin-u] visited the Soviet Union incognito. At a secret meeting held at Moscow, the USSR rebuffed once again North Korean requested for a nuclear power plant. [242] Not to be deterred North Korea turned to its East Bloc allies for assistance.

In a telegram from Pyongyang to Bucharest, the Romanian ambassador wrote: "On April 7, I was summoned by Jeong Jun-taek [Jong Jun Thaek], the vice-president of the Cabinet of the DPRK, the president of the State Planning Committee for Atomic Energy, who asked me to send a letter to the president of the Romanian Council for Atomic Energy, Horia Hulubei, in which the North Korean government expressed its will to expand technical and scientific cooperation between the two countries in the field of atomic energy. In this respect, Jeong Jun-taek pointed out that the DPRK planned to send a 7-person technical-scientific delegation working on nuclear energy to Romania in the second and third term of this year, for approximately 10 days. The aim of this trip would be for the Korean delegation to become acquainted with the successes and the experience accumulated in Romania from the research carried out on atomic energy, with a particular interest in Romania's experience with research in the areas of technology and physics, nuclear reactors, introduction of radioactive isotopes and radiations in the national economy, and with a particular interest in the Romania's research

[238] Albright, David and Kevin O'Neill, eds., Solving the North Korean Nuclear Puzzle. Institute for Science and International Security. Washington, D.C.: 2000
[239] Mansourov, Alexandre. Soviet Occupation and Early Traces of North Korea's Nuclear Activities. North Korea's Road to the Atomic Bomb. International Journal of Korean Unification Studies. Vol. 13. No. 1. 2004
[240] Kim Il Sung. Report to the Fifth Party Congress. 2 November1970. The Pyongyang Times. Pyongyang. 3 November 1970
[241] Ilpyong J. Kim, Communist Politics in North Korea, Praeger Special Studies
[242] March 13, 1967 Report, Embassy of Hungary in North Korea to the Hungarian Foreign Ministry. History and Public Policy Program. Woodrow Wilson International Center for Scholars https://digitalarchive.wilsoncenter.org/document/110621.pdf?v=7efa84f743b6a59f4a1f96bc3a0a5a18

successes on nuclear fuel and materials. The North Koreans wish to visit research institutes and industrial units using radioactive isotopes." [243] According to the telegram, Poland had also been approached.

On 17 January 1968, in an incident known as the Blue House Raid, a 31-man detachment from the Korean People's Army secretly crossed the DMZ on a mission to kill South Korean President Park Chung-hee, nearly succeeding four days later on the 21st of January. The incursion was only discovered after South Korean civilians confronted the North Koreans and informed South Korea authorities. After entering Seoul disguised as South Korean soldiers, the North Koreans attempted to enter the Blue House (the official residence of the President of South Korea). The commandos were confronted by South Korean police and after a firefight, fled Seoul and individually attempted to cross the DMZ back to North Korea. Of the original group of 31 North Koreans, 28 were killed, one was captured, and two remained. Whether they survived or not is unknown. 26 South Koreans were killed, 66 wounded, the majority of whom were soldiers and police officers. Three American soldiers died and three were wounded. On 23 January 1968, a Banner-class environmental research ship, the USS Pueblo (AGER-2) was attacked and captured by North Korean forces on what is known today as the "Pueblo incident" or alternatively, as the Pueblo crisis. After the Pueblo incident, Kim Il-sung sided with the military and ideological hard-liners mentioned above.

Czechoslovakian military attaché, Col. Goch:
In February 1968 the Czechoslovakian military attaché to North Korea, Col. Goch, reported that "for a long-time he had been receiving signals from traders that the DPRK is interested in equipment for nuclear research and is now certain that the DPRK had an active Atomic Research and Scientific Institute for a relatively long time (he is not certain if this is the correct name), which employs several hundred scientists. Since I had expressed doubt if the information is true, because where would Korea find so many scientists in the field, etc., Col. Goch said. I cannot say where I heard about it, but I give my word that it is true. [244] In the conditions here I find it hard to establish its location." Goch was right on all counts, North Korea did have an active Atomic Research and Scientific Institute, it did have several hundred scientists assigned to the project, it had gone on for a long time but, it was not that hard to find – if one knew what they were looking for. Goch should have known.

In 1968, in return for Pyongyang's allegiance during the Sino-Soviet Break, the USSR provided North Korea a radiochemical or isotope production laboratory, a K-60,000 cobalt installation, a set of UDS-10 decontamination drains, a nuclear waste storage site, a special nuclear laundry, and a boiler plant almost free. [245] The Nyongbyon Nuclear Complex was born as a product of Kim's skillful manipulation of Moscow's sensitivities and Beijing's excesses in his nascent quest for greater self-reliance, and more powerful self-defense capabilities. In other words, a geopolitical crisis in Northeast Asia created another nuclear opportunity for Kim Il-sung in 1959, and he exploited it to his advantage. [246] It was progress. On 15 April 1969 a North Korean MIG-21 shot down a US Navy EC-121 reconnaissance aircraft over the Sea of Japan. North Korea under Kim's leadership continually sought to move forward its goal of acquiring a nuclear weapons capability. It was a matter of national survival.

In November 1970, after realizing the Soviet-built 2 MWt ITR-2000 reactor in Nyongbyon was a dead end without continuous Soviet assistance, the WPK Fifth Party Congress urged the nation's nuclear establishment to follow the party's "mass line," by "trusting the creativity and the wisdom of the masses," and "to speed up the R&D in the atomic industry on the basis of indigenous nuclear raw materials and equipment to be used with maximum efficiency," as well as "to initiate our own scientific research in the field of thermonuclear reactions." [247] North Korea now zealously pursued its search for an independent nuclear weapons capability.

Following the decisions of the WPK Fifth Party Congress, in 1971, the DPRK government organized geological

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[243] April 08, 1967 Telegram from Pyongyang to Bucharest, No.76.121, TOP SECRET, April 8, 1967. History and Public Policy Program. Woodrow Wilson International Center for Scholars
https://digitalarchive.wilsoncenter.org/document/116697.pdf?v=0d8b48ef25bea4fa0a42445ee142937b
[244] February 05, 1968 Lt. Col. J. Załuska, 'Record: Information from CSSR Military Attaché, Col. Goch, obtained during a Hunt.' History and Public Policy Program. Woodrow Wilson International Center for Scholars
https://digitalarchive.wilsoncenter.org/document/208547.pdf?v=c9957fb2334faafbd7dfdffd049db90d
[245] "Report on the Work of the Soviet Specialists' Team in the DPRK on Contract # 9559/5 for the period 1963-1965" (in Russian). State Committee on Atomic Energy. USSR Council of Ministers. Moscow. 1965
[246] Mansourov, Alexandre. Soviet Occupation and Early Traces of North Korea's Nuclear Activities. North Korea's Road to the Atomic Bomb. International Journal of Korean Unification Studies. Vol. 13. No. 1. 2004
[247] Svetlana G. Nam. Education and Science in the DPRK under the Conditions of Scientific-Technical Revolution. Nauka Publishing House: Institute of Oriental Studies. The USSR Academy of Sciences. Moscow. 1975

surveys in North and South P'yong'an Provinces, in North Hamgyong Province, and in North Hwanghae Province, which confirmed the existence of significant uranium deposits in Musan-kun (North Hamgyong Province), P'yongsan-kun (North Hwanghae Province), Sunchon (South P'yong'an Province), and P'yongwon-kun (North P'yong'an Province). [248] Previous identifications of uranium at or near Hungnam, no long received mention.

In the early 1970s, North Korean nuclear scientists initiated primitive "nuclear fuel-related" research aimed at locally utilizing available nuclear raw materials. [249] In actuality as this took place quietly, the process probably took place at the Sinanju Munitions Plant. We now know – from post-Cold War studies of Soviet and Eastern European archives – that Pyongyang was hinting to the Chinese about their interest in nuclear weapons as early as the mid-1970s. [250] In June while talking to a delegation from Japan, Kim argued that North Korea had no desire for an atom weapon. [251] In December 1972, Kim Il-sung encouraged further efforts "to promote research for the development of atomic energy" during his address on the country's economic development plan. In August 1973 the DPRK signed an agreement with Poland on technical and scientific cooperation that included a provision for three North Korean technical experts to be trained in Poland in the field of nuclear technology. [252]

23 January 1974 saw the Supreme People's Assembly enact the Atomic Energy Act creating the Atomic Energy Bureau. On 29 December 1986 the bureau was transformed into the Ministry of Atomic Energy Industry of the Administrative Council under the Cabinet of Ministers. It was charged with supervising and guiding all nuclear activities, including operations at the Nyongbyon Scientific Nuclear Research Complex and various related nuclear research institutes and academic departments under the DPRK's Academy of Sciences, as well as coordinating nuclear activities with other relevant government ministries and agencies. [253]

In August 1987 Anju County was raised to the status of a city, the former Sinanju Workers' District (nodongjagu) was divided into three administrative districts; Sinwon-dong, Wonhung-dong, Yokchon-dong. The change in administrivia was incidental to the Supreme People's Assembly action of 29 December 1986 and by the sheer existence of the large underground facility south of Sinanju. Bureaucracies specialize in building themselves, growing their influence by demanding attention. A large-scale EMIS facility whose electrical power requirement would one day blackout out North Korea for nearly three decades, consuming all of its electrical power, would beg the attention and involvement of politicians, communist or not. Anyone "in the know" would want a piece of the pie. The dates were significant.

1974 would also see tremendous efforts to build out the underground and aboveground facilities at the Sinanju Munitions Plant. Nothing appears out of nowhere.

While some functions and facilities that support an EMIS could be collocated with the system in the underground facility, many could not. A steam plant is a good example of a supporting process that would not be located within the underground facility. The production of steam requires water, coal, creates dust, smoke and soot. The steam plant would be located outside the underground facility, aboveground and observable. These various functions and support facilities would be instrumental in determining just what exactly, was operating within the underground facility at the Sinanju Munitions Plant. The dissipation of waste heat, a major requirement for thermal and gaseous diffusion though probably relying on heat removal by water would require some further method to encourage water to release the waste heat within into the atmosphere. While water storage ponds might be constructed underground to hide them from view, the ponds would still require venting to open air. That air would still carry steam. That steam would again be visible on reconnaissance imagery. All three of the Sinanju Munition Facility's steam plants are located above ground.

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[248] Yonhap News Agency, Chapter Eight "Kunsa," Yonhap News Agency. Pukhan Yon'gam. Seoul. 2002
[249] KAERI, "Pukhanui Wonjaryok'iyonggaebal Hyonhwang," Seoul, http://www.kaeri.re.kr/
[250] Balasz Szalontai and Sergey Radchenko. "North Korea's Efforts to Acquire Nuclear Technology and Nuclear Weapons: Evidence from Russian and Hungarian Archives." Cold War International History Project, Working Paper #53. August 2006
[251] Kim Il-sung. Talk to a delegation of the Japan Clean Government Party. 1 June 1973. contained in Kim Il Sung. Works. Volume 19. January – December 1973. Foreign Languages Publishing House. Pyongyang, Korea. 1984
[252] Memorandum, Branch Office of the Hungarian Ministry of Foreign Trade in North Korea to the Hungarian Ministry of Foreign Trade, 11 September 1973. Woodrow Wilson International Center for Scholars https://www.wilsoncenter.org/sites/default/files/media/documents/publication/WP53_web_final.pdf
[253] ROK Ministry of Unification. Pukhan Kaeyo 2000. Ministry of Unification. Seoul. December 1999

In March 1974, Kim Il-sung admitted that for North Korea to get a bomb it would need to rely on its own people, own resources. During the Korean War of 1950, Kim Il-sung ordered Yi Hak-mun, the Yi Chung republic reconnaissance hero, to abduct Dr. Yi Sung-ki, Dr. Do Won-son, researcher Do Sang-nok, and other people from South Korea, and to be brought into North Korea for the purpose of developing nuclear arms. Beginning in the latter half of 1950s, the North Korean nuclear weapons research program in Hamhung was extended to include management of the Pungang Special District, in Yongbyon County, North Pyongan Province. The institute in Hamhung was reorganized into a branch institute and was put under charge of Dr. Yi Sung-ki. The Pungang District was developed into a basic research base, which was led by Do Won-sop and Kim To-sul. 16 September 1974 saw North Korea's entry into the International Atomic Energy Agency (IAEA). Apparently, North Korea traded access to its nuclear secrets at Yongbyon, through limited international inspections, in return for North Korean access to Western nuclear databases held by the IAEA. It was a bad trade.

The IAEA Blunders:
In 1975 Dr. Ch'oe Hak-kun was assigned as counselor to the North Korean mission to the IAEA in Vienna, Austria. North Korea's entry into the IAEA was no more than another way for its nuclear weapons program to siphon off important nuclear information contained within "Atoms for Peace" databases held by the agency.

During his four-year tenure in Vienna, Dr. Ch'oe is said to have obtained large quantities of information concerning the design of Western-built nuclear reactors and other nuclear fuel cycle technologies through the IAEA library. [254] Dr. Ch'oe was responsible for negotiating the first INFCIRC/66 trilateral safeguards agreement between the North Korea, the USSR, and IAEA, signed on 20 July 1977, which eventually allowed the IAEA to monitor the Soviet-supplied IRT-2000 research reactor and 0.1 MW critical assembly located in Yongbyon. He supervised all the North Korean dealings with the IAEA until his departure in 1979.

The entire operation was cheap and almost self-sufficient. The only visible cost of the nuclear advances made by throughout the 1980s consisted of the administrative and operational expenses incurred by the DPRK's representative office at the IAEA in Vienna. Dr. Ch'oe Hak-kun's work allowed North Korea to save the major portion of long-term research and design (R&D) expenditures that would have been required from the central budget, for any truly indigenous nuclear R&D program. R&D budgets went into the construction and expansion of the Sinanju Munitions Plant and other underground and clandestine uranium and nuclear research facilities such as, machine shops, uranium milling and bomb assembly plants.

Ch'oe Hak-kun introduced North Korea to a number of foreign nuclear technologies copied from IAEA technical manuals in Vienna, including uranium milling, uranium refinement, fuel rod fabrication, and nuclear waste storage. Undoubtedly some of the information obtained by Ch'oe made its way into operations at the Sinanju Munitions Plant. Every clandestine uranium production facility built in North Korea from the late 1970s into the end into the early 1990s was a direct result of Ch'oe's perfidy and IAEA naiveté, and no one noticed. The UN's idea of trading information for access was born dead on arrival. High-minded ideas have little impact on low-brow leaders.

In the mid-1970s, Pyongyang was rumored to have obtained some kind of "nuclear equipment" from Austria and France for its alleged underground nuclear facility near Pakch'on Air Force Base in Pakch'on-kun (North Pukto Province). [255] There was no Pakch'on Air Force Base, however that would never stop people from trying to make the information fit the circumstances.

The information was probably disinformation, gray propaganda, (a little bit true/white, a lot false/black) designed to draw attention into Pyongan-pukto, north of the Ch'ongch'on River and away from areas south of the river, such as the Sinanju Munitions Plant. Nyongbyon was just miles away, it had to be true. A well-versed analyst would however know that, in Hangul (Korean), "near" – is a relative term. The names of local features such as airfields would mean that all together, the report simply meant that the material had gone to an underground facility somewhere within about 30 miles of Pakch'on in the general direction of an airfield nearby. That, was true. Assuming that the speaker was standing in Pyongyang, his clue identified the Sinanju Munitions Plants. To lessor analysts though, the underground facility as reported became the Lost Dutchman of the North Korean nuclear program. For nearly fifty years the various ICs around the world have concentrated on the area of Pakch'on proving,

[254] Lee Chae Sung. Pukhan'ul Umjig'i'nun Technocrat. Seoul. 1998
[255] "North Korea Suspected of Building Second Nuclear Arms Base." Agence France Presse. 29 October 1991

a little lie goes a long way when truer information is lacking. Austria and France had however, been instrumental it supplying equipment to the Nyongbyon Scientific Nuclear Research Complex. [256] The material and equipment provided were either dual-use or rather common scientific equipment. It looked bad on paper, not much to see when examined in-depth.

In 1975, North Koreans began to conduct "chemistry experiments" with uranium, and performed plutonium extraction activity on a small scale by reprocessing 300 milligrams from the IRT-2000 NRR's spent fuel at the Isotope Production Laboratory in Nyongbyon. [257] In 1976, the first nuclear waste storage site was built in Nyongbyon. [258] It was most likely the second nuclear waste storage site as there was one at the Sinanju Munition Plant and probably several others somewhere in North Korea. It got worse.

In a Memorandum from the Hungarian Foreign Ministry dated 16 February 1976, the ministry wrote that "By now the DPRK also has nuclear warheads and carrier missiles, which are targeted at the big cities of South Korea and Japan, such as Seoul, Tokyo, and Nagasaki, as well as local military bases such as Okinawa. When I asked whether the Korean People's Army had received the nuclear warheads from China, they replied that they had developed them unaided through experimentation, and they had manufactured them by themselves." [259] That following March, in response to a question posed by the Chief Editor of the Japanese political magazine Sekai concerning North Korea forestalling a US nuclear attack by possessing weapons of its own, Kim replied: [260] "We have no intention of arming ourselves with nuclear weapons. We have neither enough money to produce nuclear weapons nor a suitable area to test them." [261] He lied.

Money was short, but time and distance from the events that occurred over Hiroshima in 1945 were lessening the costs normally associated with nuclear weapons and energy programs. Time was one thing North Korea had. 1976 would be a pivotal year in North Korea's quest for nuclear weapons. A decision was required, was it go, or no go? Kim made it.

1976 would also see Kim Il-sung in and around Anju-Sinanju many times, publicly he was reviewing and providing "on-the-spot guidance" to farmers and inspecting irrigation works. More likely he was inspecting the nuclear works associated with the Anju Munitions Plant but – that did not make the press.

Two months later, in April 1976, the Soviet Union would once again deny a North Korean request for a nuclear reactor. [262] During the course of negotiations, "the head of the Korean delegation – Deputy Premier Kong Jin-tae – behaved in an extremely aggressive way, definitely crude and insulting in certain statements vis-a-vis his Soviet counterpart, Deputy Premier Arkhipov." [263] Kong Jin-tae had even threatened to suspend North Korea's "its economic relations with the Soviet Union." In June the Soviet Union issued a statement indicating that: "[…] The Soviet Union cannot deliver a nuclear power plant to the DPRK in the new five-year plan [1976-80] either, for it has long-term commitments [to construct such plants elsewhere]." [264] In November 1976 Kim was once again promoting

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[256] Mansourov, Alexandre. Soviet Occupation and Early Traces of North Korea's Nuclear Activities. North Korea's Road to the Atomic Bomb. International Journal of Korean Unification Studies, Vol. 13, No. 1, 2004

[257] David Albright, Kevin O'Neill, Solving the North Korean Nuclear Puzzle. Institute for Science and International Security Press. Washington, D.C. 2000

[258] Bermudez, Joseph J. "Exposing North Korea's Secret Nuclear Infrastructure - Part Two." *Jane's Intelligence Review*. 1999

[259] February 16, 1976 Memorandum, Hungarian Foreign Ministry. History and Public Policy Program. History and Public Policy Program. Woodrow Wilson International Center for Scholars https://digitalarchive.wilsoncenter.org/document/111471.pdf?v=e354e0cf7d3cb7a2ddf0b7720050b0fa

[260] Talk with the Chief Editor of the Japanese Political Magazine Sekai. 28 March 1976. contained in Kim Il Sung. Works. Volume 19. January – December 1973. Foreign Languages Publishing House. Pyongyang, Korea. 1984

[261] Talk with the Chief Editor of the Japanese Political Magazine Sekai. 28 March 1976. contained in Kim Il Sung. Works. Volume 19. January – December 1973. Foreign Languages Publishing House. Pyongyang, Korea. 1984

[262] April 15, 1976 Report, Embassy of Hungary in North Korea to the Hungarian Foreign Ministry. Woodrow Wilson International Center for Scholars. https://digitalarchive.wilsoncenter.org/document/111473.pdf?v=797f6bdd39345dfcccf360ac37efdc1f

[263] April 15, 1976 Report, Embassy of Hungary in North Korea to the Hungarian Foreign Ministry. History and Public Policy Program. Woodrow Wilson International Center for Scholars. https://digitalarchive.wilsoncenter.org/document/111473.pdf?v=797f6bdd39345dfcccf360ac37efdc1f

[264] June 25, 1976 Telegram, Embassy of Hungary in North Korea to the Hungarian Foreign Ministry. History and Public Policy Program. Woodrow Wilson International Center for Scholars. https://digitalarchive.wilsoncenter.org/document/111475.pdf?v=d9acfaa5ad3bae04f3148ca92ca26774

research on atomic energy, the ever present peaceful nuclear energy program.[265] In his speech Kim admitted that North Korean scientists lagged behind their foreign counterparts.[266]

In the second half of the 1970s, North Korea began to explore possible technical partnerships in a Middle East, known for its emerging interest in nuclear proliferation. North Korea signed a protocol on technical cooperation with Pakistan and a cooperative agreement on science and cooperation with Libya, on 24 November 1976, and on 6 July 1977 respectively.[267] These documents established the framework for the future bilateral exchange of scientists, scientific documentation, and mutual training of specialists in various areas, including the nuclear physics. As time passed and the works at Sinanju progressed, worker transportation became an issue. Though only several hundreds of people might work inside the vast underground facilities at the Sinanju Munitions Plant, many other thousands supported the works. To meet the demand for personal transportation 8,000 bicycles were sent to Anju County.[268] Another 10,000 soon followed.[269] During WWII the Japanese had conquered Singapore on bicycle.

Also, under construction in the area was the Ch'ongch'on River Thermal Electric Plant. A coal-fired power station located in, and supported by coal from the Anju Coal Fields. The plant drew little attention. It should have.

The Ch'ongch'on River Thermal Electric Plant:
While power generated at hydroelectric power station was considered the most stable and reliable for use in uranium enrichment, most enrichment processes rely on thermoelectric plants for emergency backup operations. During the height of North Korea's EMIS operation, all but four of its thermoelectric power stations were allowed to idle and fall into disrepair: The Ch'ongch'on River, Pyongyang, Pukchang and the station at Rajin-Songbong were the only plants to continue operations. Had it not been for bunker oil provided through the Geneva Agreed Framework, the Rajin-Songbong station would have probably been allowed to sink into disrepair. Due to the provisions of the Geneva Agreed Framework, North Korea was forced to operate the plant. It probably would have preferred the plant to be shut down and idled. Several major North Korean thermal power stations under construction in the 1980s, never came online until after the country's need for a feed stock for its centrifuges, lay safely stockpiled in one of the Sinanju Munitions Plant's major underground facilities.

Depending on sources used, the Ch'ongch'on River Thermal Electric Plant's first generator came online in December 1976. It would later serve as the emergency backup plant for the Sinanju Munitions Plant. It was cheaper to maintain a spinning reserve prepared to go online immediately with a thermoelectric power station, than it is to lose stored capacity from a reservoir supporting a hydroelectric plant.

A total of six coal-fired turbine-generators would be installed in separate underground generator halls at the Ch'ongch'on River Thermal Electric Plant. The actual transmission frequency of the generators is not known. The overall capacity of the plant would reach 300 MW. Power was transmitted from the Ch'ongch'on River Thermal Electric Plant to the national-level grid through a 220-kV substation located several miles to the west, also installed during the construction of the power station. along the national-level transmission lines extending between the former Japanese-installed hydroelectric power stations located on the line Yalu River, to Pyongyang. The 220-kV substation would be instrumental in providing power to the EMIS facility. As of 1956, there was no 220-kV transformer substation located along the 220-kV powerlines extending from the Supung power station to Pyongyang.[270] The line at that time consisted of a single circuit 220-kv transmission line111-mile-long.[271] The Sinanju Munitions Plant itself receives power through a series of taps extending from two double-circuit 66-kV

[265] On Further Improving the Training of Our Cadres. Speech Delivered to the Teaching Staff of Kim Il-sung University. 28 November 1976 contained in Kim Il Sung. Works. Volume 19. January – December 1973. Foreign Languages Publishing House. Pyongyang, Korea. 1984
[266] On Further Improving the Training of Our Cadres. Speech Delivered to the Teaching Staff of Kim Il-sung University. 28 November 1976 contained in Kim Il Sung. Works. Volume 19. January – December 1973. Foreign Languages Publishing House. Pyongyang, Korea. 1984
[267] Lee Chae Sung, *Pukhan'ul Umjig'i'nun* Technocrat. Seoul. 1998
[268] On Some Immediate Economic Task Facing North Phyongan Province. Speech at an Enlarged Meeting of the North Phyongan Provincial Committee of the Workers' Party of Korea. 25-26 July 1978. contained in Kim Il Sung. Works. Volume 15. January – December 1961. Foreign Languages Publishing House. Pyongyang, Korea. 1983
[269] On Some Immediate Economic Task Facing North Phyongan Province. Speech at an Enlarged Meeting of the North Phyongan Provincial Committee of the Workers' Party of Korea. 25-26 July 1978. contained in Kim Il Sung. Works. Volume 15. January – December 1961. Foreign Languages Publishing House. Pyongyang, Korea. 1983
[270] Provisional Intelligence Report. The Electric Power Industry of North Korea. CIA/RR PR-148. Office of Research and Reports. 21 September 1956
[271] Provisional Intelligence Report. The Electric Power Industry of North Korea. CIA/RR PR-148. Office of Research and Reports. 21 September 1956

lines, spreading southward into the local area. The lines represent massive redundancy. A separate 66-kV transformer provides backup, or perhaps variable frequency power directly from the substation to the plant itself.

If the CIA identified the Sinanju Munitions Plant in 1979, there had to have been a workup or buildout period prior to its identification, the Ch'ongch'on River Thermal Electric Plant was part of that build out. The plant probably provides variable frequency power to the munitions plant to support operations conducted therein, which would explain its overall lack full-scale operation. The Sinanju Munitions Plant most likely went fully operational, accompanied by reorganizations of the government around 1986, the period that evidence began to surface that North Korea was engaged in a clandestine nuclear weapons development effort. [272] Secrecy and discipline aside, there are always whispers, background noise, that flows across borders and is talked about in dark rooms. It is important to note that, throughout the 1980s and 1990s, Kim il-sung stated publicly many times that North Korea had no desire for nuclear weapons nor the scientists and underlying infrastructure to support such a program. It was a position that Kim would maintain. Politically, Kim sought direct negotiations with the Washington, dismissing South Korea us a US lackey. Kim argued that North Korea could never attack its compatriots in South Korea. It is not so clear that North Korea felt the same about China, Russia, Japan, the Philippines, Vietnam…. Kim would always seek a nuclear-free peninsula, as long as North Korea held the nuclear weapons.

In 1980 North Korea sent 5 post-graduate students [to Czechoslovakia] in the field of nuclear physics, with a concrete program that the Czechs were compelled to reject because of the strictly confidential nature of the field. Thus, the Korean side was forced to recall its candidates for postgraduate studies. [273]

In 1981, North Korea began construction of a pilot-scale nuclear fuel rod fabrication facility in Yongbyon, which was expanded in 1986 into a full-scale fuel fabrication plant named the "August Enterprise," completed in August 1987. There were other such facilities located nearby and underground, fuel rod fabrication facilities, that continued to allude analysts who could not meld the information contained with reports, temporally, with the local facilities in existence. Their desires to identify more western mirror imaged concepts of more aesthetically pleasing facilities got the best of them.

North Korea's pursuit of nuclear weapons only popped on the radar screen of the United States intelligence community (IC) in the mid-1980s. In 1982, a CIA report analyzing the next decade of nuclear proliferation concluded that, despite the country's interest in reactors, "we have no basis for believing that the North Koreans have either the facilities or materials necessary to develop and test nuclear weapons." [274] By the mid-1980s, however, North Korea's development of a nuclear reactor started raising concern that Pyongyang might be pursuing nuclear weapons, though the IC still doubted that North Korea would risk nuclear pursuit given its vulnerability and the prospect of reactive South Korean proliferation. [275] Two decades later, North Korea would test its first fission device. 30 years later, North Korea would become the world's 10th nuclear power.

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[272] Nuclear Negotiations with North Korea: In Brief. Congressional Research Service. 7-5700. www.crs.gov. R45033. 4 December 2017
[273] 30 April 1981/ Report, Embassy of Hungary in North Korea to the Hungarian Foreign Ministry. History and Public Policy Program. History and Public Policy Program. Woodrow Wilson International Center for Scholars/ https://digitalarchive.wilsoncenter.org/document/110137.pdf?v=c6ca3f0a03d2bd47c6673f93ddb7d328
[274] CIA. "A 10-year Projection of Possible Events of Nuclear Proliferation Concern." NSA. May 1983 https://nsarchive2.gwu.edu/NSAEBB/NSAEBB87/nk02.pdf
[275] CIA. "North Korea: Potential for Nuclear Weapons Development." Sept. 1986. NSA, https://nsarchive2.gwu.edu/NSAEBB/NSAEBB87/nk07.pdf

In 1983, North Korean nuclear scientists began to "take first steps" in the uranium enrichment process of converting UO^2 to UF^6. [276] In 1984 (perhaps as early as1986), North Korea constructed a "uranium refinement facility" near its uranium mine in P'yongsan-kun (North Hwanghae Province) nicknamed the "January Enterprise" to convert uranium ore into UO^2. In 1985-1986, North Korea began the construction of a "radiochemistry laboratory" or plutonium reprocessing plant (referred to as the "December Enterprise"), with limited operations detected as early as 1989. [277] The mine's ore was obviously of low quality, if not, the Soviet Union would have taken it immediately after WWII or later as their need for high-quality uranium to support their bomb program grew. The real ore lay as stockpiles consisting of mining spoils taken by the Japanese during WWII and transported to Korea during the war. More such spoils had been obtained in Thailand during the 1970s. Lastly, in 1986-1989, North Korea constructed the so-called "Building 500" to be utilized as an undeclared waste storage facility. [278] These projects were probably installed and functioned but they were never intended to be primary facilities. Those facilities were clandestine and underground for the most part. For every known aboveground site in North Korea performing some function, there are three clandestine and underground facilities located somewhere, inefficient but meeting requirements. Success in a clandestine operation can only be guaranteed by a high level of redundancy. North Korea had that.

Dr. Ch'oe Hak-kun served the North Korean cause well however, there was nothing original, self-reliant or academic in his service. As a professional spy-technocrat trained in mining scientific and technical intelligence, he stole the treasure from the nuclear vault of the West at the IAEA headquarters in Vienna, Austria. The motherland appreciated his tremendous contribution to the development of the North Korean atomic industry and, in December 1986, Dr. Ch'oe Hak-kun was appointed the first Minister of North Korea's Atomic Energy Industry. [279] All those hot burning days Dr. Ch'oe had spent at the Xerox machine in an air-conditioned library in Vienna had paid off handsomely.

During his two official visits to the USSR in May 1984 and October 1986 Kim Il-sung personally attempted to secure advanced Soviet nuclear technology. During the period following Leonid Brezhnev's and Yuri Andropov's deaths in 1982 and 1983 respectively, there existed an opportunity for Pyongyang to improve relations with his Soviet ally. Kim hoped to loosen up international restrictions imposed on the export of sensitive technologies which would allow North Korea to benefit from greater international nuclear cooperation. [280]

In May 1984, the Great Leader requested economic aid for his stagnant country's continued development, including Soviet technical and financial assistance in the construction of four 440-MWth light-water reactors, in exchange for the DPRK's continued loyalty to the Soviet communist cause and increased military cooperation. This time, however, the Kremlin replied "thank you, but no thanks," and urged him to open the Yongbyon Nuclear Complex to Soviet-IAEA inspections, as required by the 1977 trilateral safeguards agreement but never implemented, and agree to the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), which Pyongyang refused to do in 1968 despite Moscow's insistence. Kim went home empty-handed. [281]

It wasn't until after the DPRK joined the NPT under great Soviet pressure on 12 December 1985 that Moscow agreed to sign an inter-governmental "Economic and Technical Cooperation Agreement on the Construction of a North Korean Nuclear Power Plant" arrangement with Pyongyang on 25 December 1985, concerning Soviet technical assistance in the construction of four 4400-MWe LWRs in the DPRK. Short of ground and geological surveys, the project was stillborn. Construction on the plant began in February 1990 at Sinpo, Hamgyong Namdo but, that was five years in the future. On 25 December 1991, the Soviet hammer and sickle lowered for the last time over the Kremlin. As if it were even possible, Kim's October 1986 visit to Moscow went worse. Far worse.

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[276] Kim Byong Ku. North Korean Nuclear Issues and LWR Project, KAERI/AR-552-99. Technology Center for Nuclear Control. November 1999 at http://tcnc.kaeri.re.kr/

[277] Chang Chun Ik, Pukhan Haek-missile Chonjaeng. Seoul: Somundang. May 1999

[278] Mansourov, Alexandre. Soviet Occupation and Early Traces of North Korea's Nuclear Activities. North Korea's Road to the Atomic Bomb. International Journal of Korean Unification Studies. Vol. 13. No. 1. 2004.

[279] Mansourov, Alexandre. Soviet Occupation and Early Traces of North Korea's Nuclear Activities. North Korea's Road to the Atomic Bomb. International Journal of Korean Unification Studies. Vol. 13. No. 1. 2004

[280] Mansourov, Alexandre. Soviet Occupation and Early Traces of North Korea's Nuclear Activities. North Korea's Road to the Atomic Bomb. International Journal of Korean Unification Studies. Vol. 13. No. 1. 2004

[281] Mansourov, Alexandre. Soviet Occupation and Early Traces of North Korea's Nuclear Activities. North Korea's Road to the Atomic Bomb. International Journal of Korean Unification Studies. Vol. 13. No. 1, 2004

For the final time during his visit to the USSR in October 1986, Kim Il-sung raised the issue of nuclear cooperation requesting Soviet assistance in constructing of all things, an underground nuclear powerplant. The Cold War was ending, the Soviet Union was exhausted, Kim's "looming threat of the US nuclear bombardment" as a justification, no longer bore the weight it once did. Face-to-face, Soviet leader Michael Gorbachev, replied that the USSR had no experience in building underground nuclear power stations. [282] Gorbachev continued saying that times had changed and North Korea should not worry too much about the prospects of nuclear war on the peninsula. Kim Il-sung departed Moscow frustrated. In turn, the Kremlin was left puzzled: Why on earth would a "peaceful nuclear program" need underground nuclear reactors, unless the North Koreans wanted to develop in hiding, a clandestine plutonium production capability? [283] Perhaps Kim knew more about underground facilities than Soviets. As it was, Kim already had an underground uranium enrichment process and was building Soviet-style nuclear weapons storage facilities across North Korea.

In hindsight, North Korea was probably already building such a reactor, but it would never be connected to the country's national electrical power grid, probably not its distribution grid, but through its sub-distribution grid. Besides, North Korea's national electric power grid probably could not support electrical power loading to its rated capacity. If it had independent sources of electrical power, there is no requirement for a plutonium producing reactor to be connected to the regional electrical power grid or the national electrical power grid. Kim's reactors were never intended to produce electrical power to improve the lives of North Koreans but, to produce plutonium. If North Korea could build a nuclear reactor in Syria, it is only because they had successfully built one, perhaps several, in Korea. [284] Plutonium-producing, graphite-moderated, reactors.

North Korea's first home-made *juch'e* reactor went into operation almost thirty years after the communist North launched its nuclear exploration program. Nuclear developments proceeded at a snail's pace in the domain of the Great Leader. The "Yongbyon Experimental Nuclear Power Plant No. One," turned out to be nothing more than a poorly enlarged and copied replica of a 1950s-vintage Western atomic reactor. Plant Number One was modeled after the UK's Calder Hall reactor. It is a graphite-moderated, gas-cooled reactor with a thermal power range of 20-25MW. Construction of the reactor began in 1979 and was completed by 1986. All three subsequent "indigenous" nuclear reactors built by North Korea in the 1980s could produce electric power, albeit inefficiently, but were far better suited to maximize plutonium production. None were ever connected directly to North Korea's national grid. The plants were supported by sub-distribution grids connected to regional grids and independent backup generators.

In the second half of the 1980s, as controls on better satellite imagery began to loosen, some outside observers began to study the random photographs of the Yongbyon Nuclear Complex more closely, and questioned the so-called peaceful nature of the North Korea's nuclear program. Such imagery would also include frames of the Sinanju Munitions Plant located only about 18 miles away. Eventually, historians familiar with the Japanese Occupation, the industries and other efforts during the period would ultimately be drawn to such platforms such as Google Earth, to discover what has eventually became of those Japanese industries and civil engineering projects located in North Korea and largely destroyed during the Korean War. The country had been virtually closed to outside observers since before the Korean War, current satellite imagery provided a window to the past. Historians used it.

As the 1990s progressed, North Korea's investment in the Middle East began to pay dividends in the form of one man, Pakistan's A.Q. Khan.

A.Q. Khan:
Khan was born in Bhopal, British India, into a Khanzada Rajput family that settled in India in 12th century. His mother, Zulekha Begum was of Mughal origin. His father, Abdul Ghafoor Khan, was a graduate of Nagpur University and an academic who served in the Indian Education ministry, then settled the family in Bhopal State after he retired in 1935. After the partition of India in 1947, his family emigrated from to Pakistan in 1952 and settled in Karachi, Sindh Province. Briefly attending the D.J. Science College, Khan enrolled at Karachi University in 1956 to study physics. In 1960, he graduated with a degree in physics with a minor in mathematics. His area of expertise was solid-state physics.

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[282] Vadim P. Tkachenko, Korean Peninsula and Russian Interests. Vostochnaya Literatura. Moscow. 2000

[283] Mansourov, Alexandre. Soviet Occupation and Early Traces of North Korea's Nuclear Activities. North Korea's Road to the Atomic Bomb. International Journal of Korean Unification Studies, Vol. 13, No. 1, 2004.

[284] Serr, Marcel. North Korea Built a Nuclear Reactor for Syria (And Israel Destroyed It). A scary fact you may not have known. The National Interest. 4 January 2019. https://nationalinterest.org/blog/the-buzz/north-korea-built-nuclear-reactor-syria-israel-destroyed-it-23922

For a short time, Khan worked for the Karachi city government as an inspector of measures. In 1961, he went to Germany to study metallurgy at the Berlin Technical University, but later transferred to Delft University of Technology in the Netherlands in 1965. At Delft, he obtained an engineer's degree in technology (equivalent to a Master of Science) in 1967 and joined the Catholic University of Leuven for his doctoral studies in 1972. Supervised by Martin Brabers at Leuven University, Khan received a D.Eng. degree in metallurgical engineering in 1972. Upon a recommendation by Brabers, Khan joined the senior staff of the Physics Dynamics Research Laboratory in Amsterdam.

Khan's initial studies in Amsterdam were on the high-strength metals used in the development of centrifuges. Gas centrifuges were first conceived by American physicist Jesse Beams as part of the Manhattan Project but studies were discontinued in 1944. The Physics Dynamics Research Laboratory was a subcontractor for the Urenco Group which was operating a uranium enrichment plant in Almelo, Netherlands. Established in 1970, Urenco employed the centrifuge method to assure a supply of enriched uranium for nuclear power plants in the Netherlands. When Urenco offered him work joining the senior scientific staff, Khan left the Physics Laboratory where he then performed physics experiments on uranium metallurgy, to produce reactor-grade uranium usable in light water reactors (LWR). Urenco used the Zippe-type gas centrifuges – a method invented by German mechanical engineer Gernot Zippe under contract post-WWII, to the Soviet atomic bomb program. Urenco used the Zippe method to separate fissile isotopes U^{235} from non-fissile U^{238} by spinning UF^{6} gas at speeds beyond 100,000 rpms.

Khan's pioneering research led to the improvement of the Zippe method, which at that time, was an emerging technology and whose publications were classified in the Soviet Union. Khan's cutting-edge research in metallurgy brought laurels to Urenco, which hailed him as one of the senior scientists at the facility where he researched and studied. His pioneering investigations greatly improved the technological efficiency of the Zippe method; eventually, Urenco gave Khan access to all blueprints for the Zippe centrifuge to study mathematical solutions for the existing physics problems in gas centrifuges.

On 20 January 1972, President Zulfikar Ali Bhutto approved a crash program with scientists at Multan to develop an atomic bomb after a seminar, known historically as – the Multan meeting. Reporting directly to Bhutto, the program was managed by Munir Ahmad Khan, the chairman of the Pakistan Atomic Energy Commission (PAEC); the outcomes of Pakistan's 1971 war (Indo-Pakistani War of 1971) with India had greatly threatened Pakistan's strategic position. Earlier Pakistani efforts had concentrated on an implosion-type nuclear weapon using military-grade plutonium – much more difficult to achieve than a uranium gun-type weapon but, at a time before widespread proliferation of centrifuges, a lot cheaper. With his knowledge of centrifuges, experience with uranium and support for an "Arab bomb," Kahn would go on to contribute greatly to the proliferation of uranium enrichment technologies, nuclear weapons and a general lessening of the former high costs associated with uranium enrichment technologies.

Following India's surprise "Smiling Buddha" underground nuclear weapons test in 1974, Bhutto accelerated Pakistan's effort to attain atomic capability. Sensing the importance of the test, Munir Ahmad launched the secretive Project-706. Learning of the Indian nuclear test, Khan sought to enhance Pakistan's military posture. He approached Pakistan government officials, who dissuaded him, saying it was as "hard to find" meaningful work in the PAEC as a "metallurgist." Undaunted, Khan wrote to Prime Minister Bhutto, highlighting his specific experience, and encouraged him to develop an atomic bomb using military-grade uranium.

Like the earliest nuclear weapons states, the PAEC did not forgo EMIS research and a parallel program was conducted by theoretical physicist G.D. Alam at Air Research Laboratories (ARL) located at Chaklala PAF base, though G.D. Allam had never seen a centrifuge, and had only rudimentary knowledge of the Manhattan Project.

According to Kuldip Nayyar, although the letter was received by Prime minister Secretariat, Khan was still an unknown entity to the Pakistani government, leading Bhutto to ask Pakistan's Inter-Service Intelligence (ISI) agency to run a complete background check and prepare an assessment report on him. The ISI assessed him as "incompetent" but Bhutto was unsatisfied and eager to know more, eventually asking Munir Ahmad to dispatch a PAEC team to meet him. The PAEC team, including Bashiruddin Mahmood, arrived at Almelo at Khan's family home at night. After an interview, the team returned to Pakistan and Prime Minister Bhutto decided to meet with Khan, directing a confidential letter to him. Soon after, Khan took a leave from Urenco, and departed for Pakistan.

In 1974, Abdul Qadeer Khan went to Pakistan and took a taxi directly to the Prime Minister Secretariat. The session with Bhutto was held at midnight and was conducted under extreme secrecy where Qadeer Khan met with Bhutto, Munir Ahmad, and Mubashir Hassan – Bhutto's Science Adviser. At the meeting, Khan emphasized the importance of uranium as opposed to plutonium, but Bhutto remained unconvinced. Bhutto ended the session quickly, remarking: "He seems to make sense." Early the next morning another session was held where Khan again focused the discussion on HEU against plutonium with other PAEC officials. Khan explained to Bhutto why he thought the idea of "plutonium" would not work. Many of the theorists at that time, including Munir Khan maintained that "plutonium and the fuel cycle has its significance." They insisted that with the "French extraction plant in the offing, Pakistan should stick with its original plan." Bhutto did not disagree but saw the advantage of mounting a parallel effort toward producing weapons-grade HEU. Bhutto was correct, due to US pressure, the French plant would not arrive for 16 more years, 1990. [285] At the final session with Zulfikar Bhutto, Khan advocated for the development of a fused design to compress the single fission element in the metalized gun-type atomic device, which many of his fellow theorists' thought would be unlikely to function. [286]

In 1975, Khan joined the atomic bomb program, and became a member of the enrichment division at PAEC, collaborating with Dr. Khalil Qureshi – a physical chemist who performed indispensable calculations which became important contributions to centrifuges, and was a vital link to nuclear weapon research. [287] Khan continued to press his ideas for uranium methods even though they had a low priority, with most efforts still aiming for military-grade plutonium. Because of his interest in uranium, and his frustration at having been passed over for director of the uranium division (the job was instead given to Bashiruddin Mahmood), Khan refused to engage in further calculations which caused tension with other researchers. [288] Khan grew to become highly unsatisfied and bored with the research led by Mahmood; finally submitting a critical report to Bhutto, in which he explained that the "enrichment program" was nowhere near success. [289]

Reading Khan's report, Prime Minister Bhutto saw issues as scientists seemed split between military-grade uranium and plutonium. Bhutto summoned Khan for a meeting and, with the backing of Bhutto, Khan replaced Bashiruddin Mahmood at PAEC and took charge of the enrichment division; separating the division into the Engineering Research Laboratories (ERL). Isolating ERL from PAEC involvement, Khan requested the division's reassignment to the Pakistani Corps of Engineers which was granted by the government in 1976. [290] It was strangely, reminiscent of the WWII-era Manhattan Project which was placed under control of the US Army Corps of Engineers. The Engineer-in-Chief directed Brigadier Zahid Ali Akbar of Corps of Engineers to work with Qadeer Khan in ERL. The Pakistani military now recognized the dangers of atomic experiments being performed in populated areas and thus remote Kahuta was considered an ideal location for research. The Corps of Engineers and Brigadier Akbar quickly acquired the lands of the village of Kahuta for the project. [291] Again, the ghost of the WWII-era Manhattan Project with its requirement for isolation and land once hoovered over the Pakistani project as it would heavily on the North Korean Sinanju Munitions Plant. ERL then became KRL, the Kahuta Research Laboratories, normally referred to as the Khan Research Laboratories. Bhutto would subsequently promote Brigadier Zahid Akbar to Major-General and place in his hands the directorship of KRL, with Qadeer Khan being its senior scientist. [292]

On 5 July 1977 Muhammad Zia-ul-Haq deposed Bhutto in a military coup and declared martial law.

Zia placed Pakistan's entire nuclear energy project in the administrative hands of Major-General Akbar who was soon made the Lieutenant-General and Engineer-in-Chief of the Pakistan Army Corps of Engineers to deal with the

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[285] TEMPEST, RONE. France to Sell Nuclear Plant to Pakistan. Los Angeles Times. 22 February 1990

[286] Khan, Feroz Hassan. "The clash of the Khans: Centrifuge Khan vs. Reactor Khan." Eating Grass: The Making of the Atomic Bomb. Stanford, California: Stanford University Press. 7 November 2012

[287] Nyäzie, Causar and Sani Panwjap. "The Reprocessing Plant – The Inside Story," Last days of Prime minister Zulfikar Ali Bhutto, Islamabad. Islamabad Capital Territory: Maulana Causar Nyazie. May 1994

[288] Nyäzie, Causar and Sani Panwjap. "The Reprocessing Plant – The Inside Story," Last days of Prime minister Zulfikar Ali Bhutto, Islamabad. Islamabad Capital Territory: Maulana Causar Nyazie. May 1994

[289] Nyäzie, Causar and Sani Panwjap. "The Reprocessing Plant – The Inside Story," Last days of Prime minister Zulfikar Ali Bhutto, Islamabad. Islamabad Capital Territory: Maulana Causar Nyazie. May 1994

[290] Nyäzie, Causar and Sani Panwjap. "The Reprocessing Plant—The Inside Story," Last days of Prime minister Zulfikar Ali Bhutto, Islamabad. Islamabad Capital Territory: Maulana Causar Nyazie. May 1994

[291] Khan, A. Qadeer. "Bhutto, Zia-ul-Haq And Kahuta." A.Q. Khan. July 2009

[292] Shahid-ur-Rehman. "The Gas centrifuge controversy." Long road to Chagai. Islamabad: Shahid-ur-Rehman, 1999.

authorities whose co-operation was required. Akbar consolidated the entire project by placing the scientific research under military control, setting boundaries and goals. Akbar proved to be an extremely capable officer in the matters of science and technology and aggressively led the development of nuclear weapons under Munir Ahmad Khan and Abdul Qadeer Khan through the next five years. [293] Again, the temperament of US Manhattan Project hung over the Pakistani program, firm guidance was needed, guidance that in the US had been provided by then-Brigadier General Leslie Groves.

Khan's eventual proliferation network was originally established to acquire knowledge on electronics materials for centrifuge technology at the ERL by K, in the 1970s. This atomic network was subsequently used by Libya, North Korea, Iran and China as media reports first surfaced on trade negotiations between China and Pakistan for the sale of [UF^6] gas and HEU. Allegations were made that "Khan paid a visit to China to provide technical support to the Chinese nuclear program when building a HEU plant in China's Hanzhong city." The Chinese government offered nuclear material from their side, but Pakistan refused, calling it a "gift of gesture" to China. According to an independent IISS (International Institute for Strategic Studies) report, Zia had given Khan a "free hand," unlimited import and export access to him. The report showed that his acquisition activities were not supervised by Pakistan governmental authorities; his activities went undetected for several years.

In the 1980s Khan, reportedly, began to develop his export network and ordering twice the number of components necessary for the indigenous Pakistani program. This transition from importer to exporter of centrifuge components was, apparently, completely ignored by western intelligence services who believed Khan was only working on Pakistan's domestic nuclear weapons program at the time. In the mid-part of the decade Khan and his network of international suppliers are reported to have begun nuclear transfers to Iran. The period of cooperation is thought to have continued through 1995 when P-2 centrifuge components were transferred to the Mullahs. The Pakistani government claims no transfers occurred after the shipments of P-1 components and sub-assemblies from 1989 to 1991. Acting on a tip, German intelligence begins to investigate potential Pakistani assistance to Iraq, and possibly Iran and North Korea, concerning processes related to melting uranium.

In 1987 KRL began to publish publicly, available technical papers that outlined some of the more advanced design features Khan had developed. The papers included information that would normally be classified in the US and Europe and showed that KRL was competent in many aspects of centrifuge design and operation. The papers also included specifications for centrifuges of maraging steel that could spin faster than earlier aluminum designs. In 1991, KRL published details on how to etch grooves around the bottom bearing to incorporate lubricants. These technical developments were proliferated from Khan's P-2 centrifuges.

In 1992 Pakistan initiated missile technology exchanges with North Korea. Within Pakistan, the KRL was one of the laboratories responsible for missile research assigned to develop the Ghauri missile with North Korean assistance. This cooperation probably established the connections and transportation routes that Khan would later use to transfer nuclear technologies. However, little is known about when nuclear transfers began, what nuclear components might have been obtained by North Korea, and whether or not the Pakistani government was privy to Khan's activities.

In the mid-1990s Khan traveled to North Korea where he received technical assistance concerning the development of the Ghauri missile, an adaptation of the North Korean No Dong design. Khan made at least 13 visits to North Korea before his public confession in 2004 and is suspected of arranging a barter deal (North Korea's favorite trade mechanism) to exchange nuclear and missile technologies, though the details of the nuclear transfers remain unknown or classified. Khan traveled with military personnel from KRL.

These Pakistani military officers assisted in the transfer of nuclear technology; programs under the Ministry of Defense were exempt from normal export controls. That the military presence, included personnel who traveled to North Korea, indicates that the Pakistani government was all too aware of Khan's activities. A claim that Pakistan continues to deny today.

In 1996 visits of North Korean and Pakistani officials accelerated, but it is not known if these meetings included discussions of nuclear transfers or deal exclusively with missile technologies. Smart money says they did.

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[293] Rahman, Shahidur. Long Road to Chagai. The General and the Atomic Toy. Oxford, Islamabad, and New York: Printwise Publications. 1999

A technical delegation from the A.Q. Khan Research Labs visited Pyongyang in the summer of 1996. The secret enrichment plant was said to be based in caves near Kumchang-ni, 100 miles north of Pyongyang, some thirty miles north west of the plutonium production reactor at Yongbyon. Defectors have located the plant at Yongjo-ri, Taechon, Mount Chonma or Ha'gap 20 miles northeast of Yongbon-kun, where US satellite photos showed tunnel entrances being built. [294] The facilities at the Sinanju Muntions Plant are located less than 50 miles from Pyongyang suggesting that this was not the facility visited by the Kahn delegation however, there are many factors at play in the tales told by members of A.Q. Khan's group.

First and foremost is that members of the Khan group had every reason to lie or mislead US investigators. They had been caught in the worse possible circumstances, the proliferation of nuclear technologies. Second is the matter of distances. Pakistanis normally measure distances by time, not kilometers or miles. In the 1990s North Korean officials were notorious for leading members of non-governmental agencies involved in food aid around the country off the beaten path. They were known for taking food aid personnel into the same valleys several times, from different directions, to heighten the sense of the disaster and increase aid dollars received. Misery was not an opportunity to be sold lightly. Where they went could more likely be determined by drawings of what they had seen when they got there than through time spent getting there or distance traveled.

Khan is suspected of beginning nuclear transfers to North Korea around 1997, though the dates of the first transfers probably remain classified. Transfers to North Korea are believed to have continued through 2003, but the Pakistani government claims these transfers ceased in 2001. Over this period, Khan may have supplied North Korea with old and discarded centrifuge and enrichment machines together with sets of drawings, sketches, technical data, and depleted uranium hexafluoride.

Trade and diplomatic relations were established between Pakistan and North Korea under Prime Minister Zulfikar Bhutto's leadership in the 1970s. After Prime Minister Benazir Bhutto's (Zulfikar Bhutto's daughter who also served as Pakistan's Prime Minister) state visit to North Korea in 1990, it was reported that highly sensitive uranium enrichment information was being exported to North Korea in exchange for missile technologies. On multiple occasions, after he was exposed as a nuclear profiteer, Khan alleged that Benazir Bhutto had "issued clear directions" for his actions. [295] In Pakistan at least, Khan had top cover.

It is believed that KRL, Pakistan's main nuclear weapons facility, may have provided North Korea with some blueprints, sample equipment, and technical assistance in the development of G-2 centrifuge technology for uranium enrichment in exchange for the technology transfers related to the North Korean Nodong missile program. North Korea is even alleged to have employed some nine Pakistani nuclear scientists in its HEU program, who have been missing since they left their country in 1998.

Much of what A.Q. Khan admitted to in 2004 was however, unlikely, and reports issued regarding his perfidy were largely false and heavily biased against the North Koreans. At least what we the American people have been told and probably what the IC told itself, as it seems to have been unable to locate North Korea's uranium enrichment program after North Korean diplomats admitted it existence in October 2002. It fits the fiction.

The Sinanju Munition Plant was identified by the CIA in 1979, its large-scale underground facilities and electrical power support systems apparently remained largely unchanged over the next decade, though construction and upgrading would be near continuous, a signature of nuclear works. According to news reports and leaks of intelligence throughout the 1980s, with the Sinanju Munition Plant in existence, and the IC's in-depth searches for North Korea's uranium enrichment facilities after its diplomats' admissions in 2002 failing, North Korea had its own centrifuge designs operating in the underground facility sometime around 1986. The materials provided by A.Q. Khan may have updated and improved the systems then operating at the Sinanju Munition Plant but, those improvements, if necessary, would have occurred naturally over the years as North Korea's experience with its own systems grew. As seen earlier, North Korea had the capability to produce its own uranium hexafluoride two decades before Khan even arrived. What is depleted uranium hexafluoride anyway?

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[294] Lowry, David. Dr. Former director, European Proliferation Information Centre (EPIC). How best to arm Britain in a changing world? The Times. LETTERS. 3 May 2013 http://drdavidlowry.blogspot.com/2013/05/

[295] IISS reports. A.Q. Khan and onward proliferation from Pakistan. The International Institute for Strategic Studies (IISS). 2006–2012

If North Korea had gotten drawings, sketches, technical data, it was probably for a bomb design, not for centrifuges or EMIS. However, many aspects of the Khan network remain mysterious, including sources for some necessary centrifuge components and details about suspected transfers to North Korea. After the debriefing of Khan and his revelations concerning centrifuges, interest in any other uranium enrichment process possibly being used in North Korea was ignored. If the IC could fail in locating North Korea's primary uranium enrichment facilities, how could it ever expect to locate small, isolated centrifuge facilities? Khan had been exposed, Khan had been shamed, Khan had been debriefed by experts but, Khan had lied – or his interrogators had only heard what they wanted to hear. Few know.

During a 23 Nov 2010 briefing, former Los Alamos National Laboratory Director Siegfried Hecker said that North Korean officials had showed him a facility containing about 2,000 gas centrifuges to enrich uranium. North Korean technicians claimed that the centrifuges were operating and producing low-enriched uranium (LEU) for a light-water reactor (LWR) Pyongyang revealed it was constructing earlier in the month, Hecker said. Hecker said that "it was just stunning" to see "hundreds and hundreds" of centrifuges at the plant rather than the "couple of dozen" he was expecting. Pyongyang first publicly admitted to an enrichment program in June of last year, stating in September 2009 that the "experimental phase" of those efforts had been completed. [296] Hecker estimated that the facility is capable of producing two metric tons of LEU each year. That amount would be appropriate for fueling a reactor of the size North Korea intends to construct or for producing up to 40 kilograms of HEU, which is enough for one to two nuclear weapons. [297]

National Carelessness:
Even as early as 1985 the IC was cautious about judging the actual intent of Pyongyang's efforts. In a paper published that same year, the National Intelligence Council (NIC) noted there was no evidence that North Korea was building a reprocessing facility or working on development of a nuclear explosive device. The paper also stressed disincentives for North Korean nuclear weapons development, including the possibility that South Korea would "be provoked to do likewise" or that the Soviet Union or China would react negatively, fat chance. [298] After the collapse of the Soviet Union in 1991 there was a dramatic shift in the tone and tenor of US intelligence assessments. It was suspected that many former Soviet nuclear scientists, now unemployed, would drift into North Korea to support their project, apparently – they didn't. In contrast to previous nuanced and cautious assessments of weapons intent, a December NIC memorandum judged that potential economic sanctions "would not cause North Korea to abandon its nuclear weapons program." [299]

A NID (National Intelligence Daily) article the next month reported that North Korea had conducted its first high-explosive (HE) test since 1988 and could be preparing to operate its reprocessing complex, "suggesting Pyongyang is moving forward with its nuclear weapons program."[300]

In early 1992, the IC developed a new-found pessimism over North Korea's program. Its concern clashed with policy optimism inspired by developments on the diplomatic and inspection fronts. On 25 February 1992, Director of Central Intelligence Robert Gates, who had been following the issue as CIA's deputy director for intelligence and as chairman of the NIC, told the House Foreign Affairs Committee that North Korea was "from a few months to a couple of years" from having a nuclear weapon. [301] Unlike plutonium, gun-type uranium weapons did not require testing. With Sinanju Munitions Plant identified in 1979 and probably coming online in 1985 or 1986, it was however, just a matter of time. Oddly enough, Kim Il-sung spend most of 1986 talking not about irrigation or

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[296] Crail, Peter. N. Korea Reveals Uranium-Enrichment Plant. ARMS CONTROL TODAY. https://www.armscontrol.org/act/2010-12/n-korea-reveals-uranium-enrichment-plant
[297] Crail, Peter. N. Korea Reveals Uranium-Enrichment Plant. ARMS CONTROL TODAY. https://www.armscontrol.org/act/2010-12/n-korea-reveals-uranium-enrichment-plant
[298] National Intelligence Council "The Dynamics of Nuclear Proliferation: Balance of Incentives and Constraints." NIC-M-85-10001. September 1985. https://www.cia.gov/library/readingroom/docs/DOC_0000453458.pdf
[299] National Intelligence Council Memorandum, "North Korea: Likely Response to Economic Sanctions," December 1991. https://www.cia.gov/library/readingroom/docs/DOC_0005380437.pdf
[300] National Intelligence Daily. "Special Analysis: North Korea: Implications of Nuclear Accord." 6 January 1992. https://www.cia.gov/ library/readingroom/docs/DOC_0001085725.pdf., cited in Froscher, Torrey. North Korea's Nuclear Program: The Early Days, 1984–2002. An Intelligence Perspective. Studies in Intelligence Vol. 63, No. 4 (Extracts, December 2019). https://www.cia.gov/library/center-for-the-study-of-intelligence/csi-publications/csi-studies/studies/vol-63-no-4/pdfs/DPRK-Nuclear-Program-Early-Days.pdf
[301] Froscher, Torrey. North Korea's Nuclear Program: The Early Days, 1984–2002. An Intelligence Perspective. Studies in Intelligence Vol. 63, No. 4 (Extracts, December 2019). https://www.cia.gov/library/center-for-the-study-of-intelligence/csi-publications/csi-studies/studies/vol-63-no-4/pdfs/DPRK-Nuclear-Program-Early-Days.pdf

farming but about his worries concerning a US nuclear attack or nuclear domination of the Korean Peninsula. [302] Apparently, his private anxieties were seeping through into his public statements. Irrigation was no longer his primary concern, in 1987, he even admitted it. [303] In his recorded works from May 1986 to December 1987 he would mention the word "nuclear" 262 times. [304] His mention of irrigation dropped to a lowly 64 times. [305]

By the summer and fall of 1992, the IAEA was also becoming concerned about inconsistencies in Pyongyang's declaration. IAEA officials were particularly worried about the possibility that more plutonium had been separated than the roughly 100 grams previously declared. The IAEA, having just seen firsthand Iraq's massive nuclear program after US forces had defeated Iraqi forces the year before, had been stunned and was newly sensitized to clandestine nuclear activity – something that not been its traditional focus. [306]

During this period, US intelligence played a key role in supporting the IAEA by providing imagery of what appeared to be camouflaged nuclear waste sites near the reprocessing plant. [307] Given access to the sites, the IAEA could have analyzed any nuclear waste they might contain and move toward a determination of the amount of plutonium North Korea had previously produced. Ultimately, Pyongyang refused to allow access to the sites which led to a formal IAEA request for "special inspections" of the camouflaged sites. In March 1993, rather than comply, North Korea surprised the United States and others by announcing its intention to withdraw from the NPT. [308] Neither the UN or US sought access to the Sinanju Munitions Plant.

In June 1993, Washington persuaded Pyongyang to suspend its withdrawal from the NPT and accept a regular IAEA presence at Yongbyon. However, the North asserted a "special status" under the NPT, and dealings with the IAEA proved to be contentious. The crisis deepened in April 1994, when Pyongyang began to refuel the 5 MWe reactor, which by then contained in its spent fuel rods, enough plutonium for four or five nuclear bombs.

In June, as the United States pursued sanctions resolutions at the United Nations and considered beefing up its forces in South Korea, former President Jimmy Carter met with North Korean Premier Kim Il-Sung in Pyongyang. After the meeting, Carter reported that North Korea was willing to "freeze" its program – i.e., forgo reprocessing of the spent fuel or further operation of the reactor—in return for high-level talks with the United States. Ultimately, after another several months of negotiations the United States and North Korea signed the Agreed Framework on 21 October 1994. The deal was built upon the assumption that, the only North Korean problem worth worrying about was plutonium. This issue of the "uranium route" was politically sensitive, because if indeed the North were pursuing uranium bombs while reaping rewards for suspending plutonium work, the Clinton Administration had been taken for a ride by one of the world's foremost nuclear proliferators. [309] The Agreed Framework eventually failed.

While the confrontation over special inspections was taking place, the IC produced its first NIE on the North Korea nuclear issue. The November 1993 estimate reportedly judged that there was a "better than even chance" that North Korea had already produced one or two nuclear weapons. [310] At that time, the CIA was probably spot on. The NIE was the high-water mark of IC estimates. Never again would US IC estimates be so prescient. From here on out it was downhill. In 2004, Arms Control Today summarized the IC's assessment of the situation:

> "Public CIA assessments about the program have changed significantly during the past year. The CIA said in November 2002 that North Korea was 'constructing a centrifuge facility' capable of producing 'two or

[302] Kim Il Sung. Works. Volume 39. January 1985 – December 1986. Foreign Languages Publishing House. Pyongyang, Korea. 1981
[303] On Some Problems in the Preparation for Farming and in the Economic Work for this Year. Speech Delivered at a Consultative Meeting of the Senior Officials of the Administration Council. 30 March 1987. Kim Il Sung. Works. Volume 39. May 1986 – December 1987. Foreign Languages Publishing House. Pyongyang, Korea. 1995
[304] Kim Il Sung. Works. Volume 39. May 1986 – December 1987. Foreign Languages Publishing House. Pyongyang, Korea. 1995
[305] Kim Il Sung. Works. Volume 39. May 1986 – December 1987. Foreign Languages Publishing House. Pyongyang, Korea. 1995
[306] David Fischer, History of the International Atomic Energy Agency: The First Forty Years (IAEA, Vienna, 1997), 115, 285. http://wwwpub.iaea.org/MTCD/publications/PDF/Pub1032_web.pdf
[307] David Fischer, History of the International Atomic Energy Agency: The First Forty Years (IAEA, Vienna, 1997), 115, 285. http://wwwpub.iaea.org/MTCD/publications/PDF/Pub1032_web.pdf
[308] Wit, Joel. Daniel Poneman, and Robert Gallucci. The First North Korean Nuclear Crisis: Going Critical. Brookings. 2004
[309] Christopher Ford. Some Thoughts on How Not to do WMD Intelligence: Lessons of Politicization After Iraq. The Hudson Institute. 4 January 2010. https://www.hudson.org/research/9122-some-thoughts-on-how-not-to-do-wmd-intelligence-lessons-of-politicization-after-iraq
[310] Stephen Engelberg, with Michael Gordon, "Intelligence Study says North Korea has Nuclear Bomb," New York Times, 26 December 1993 at http://www.nytimes.com/1993/12/26/world/intelligence-study-says-north-korea-has-nuclear-bomb.html

> more nuclear weapons per year,' perhaps as soon as 'mid-decade.' Assistant Secretary of State James Kelly told Congress in March 2003 that the facility could start producing fissile material in 'months not years.'"
>
> "Subsequent CIA reports have been increasingly vague. For example, a November report covering the last half of 2002 says only that North Korea 'had begun acquiring material and equipment for a centrifuge facility,' with the apparent 'goal' of building a plant." [311]

Officially progress on the visible "indigenous" North Korean nuclear program, its plutonium effort, was frozen in 1994 under the Geneva Agreed Framework signed by North Korea and the United States as a way to resolve the first nuclear crisis that erupted on the Korean peninsula in the early 1990s. Its uranium program was however, believed ignored by the agreement. Technically, the Sinanju Munitions Plant was not a known or suspected nuclear facility. For that matter, neither were the imaginary facilities at Chonma and Pakch'on. In addition, North Korea never began a uranium enrichment program after the Agreed Framework was signed, the program has begun years before. Ambassador Robert Gallucci however, left the North Koreans in no doubt that that any uranium enrichment program would violate the Agreed Framework. Ambassador Gallucci testified before Congress in December 1994 that the Agreed Framework required North Korea to implement the North-South Joint Denuclearization Declaration, which precludes any reprocessing or enrichment capability. "If there were ever any move to enrich," he told this Committee, "we would argue they were not in compliance with the Agreed Framework." [312]

Geneva Redux:

The Geneva Agreed Framework called for 500,000 metric tons of heavy fuel oil (HFO) to be provided to North Korea annually while two LWRs were constructed, through the Korean Peninsula Energy Development Organization (KEDO), a consortium first formed by the United States, Japan, and South Korea. From 1995 to 2002, the United States provided over $400 million in energy assistance to North Korea through KEDO. Supplying North Korea with a nuclear power plant was controversial in Congress, particularly after Republicans took control of the House of Representatives in 1995. US contributions covered heavy fuel oil shipments and KEDO administrative costs. South Korea and Japan funded the bulk of the LWR construction costs. Beginning in 1998, Congress required the President to certify progress in nuclear and missile negotiations before allocating money to KEDO operations. The Clinton Administration viewed this conditionality as fatal to the Agreed Framework, and it nearly disrupted several appropriations requests. The Clinton administration then moved to politicize intelligence and limit congressional access to any information that might reveal North Korea's uranium program. The framework did not collapse until 2002-2003, not long after a highly charged confrontation between US negotiator, James Kelly, and the North Korean delegation in October 2002 over alleged covert uranium enrichment in North Korea. There is little difference between "good" cheating and "bad" cheating.

Correct as the NIE was, US policymakers were opposed to its findings. The estimate was controversial in the policy community to say the least. In their book recounting events in this period, three key policymaking participants wrote that the estimate "shed no light but plenty of heat." [313] In their view, no one could know whether Pyongyang had nuclear weapons, and the estimate amounted to "precision without accuracy," damaging administration credibility and handing ammunition to its critics. [314] Apparently, our blended government; employees, contractors and servicemembers of several millions of people, can handle only one crisis at a time and not well at that.

Another observer claimed that the estimate "strengthened North Korea's bargaining position and nearly led to war." [315] An armed conflict, even with national security directly threatened was one thing that no policymaker wanted to consider. Policymakers do not direct national policy, the president does but, policymakers could ensure that the president remained in the dark and they did. Policymakers wanted solid evidence, the IC had information, the two are not the same. Even had the US had the evidence, as it did with the Japanese atomic energy and weapons program after WWII, it would have found some way of pushing such evidence into some dark corner in some government agency to gather dust. But evidence does exist.

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[311] Kerr, Paul. Deconstructed: North Korea's Nuclear Programs. Arms Control Today. No. 34. January/February 2004. www.armscontrol.org/act/2004_01-02/Deconstructed.asp

[312] James A. Kelly, Assistant Secretary for East Asian and Pacific Affairs. Statement to the Senate Foreign Relations Committee. Washington, DC. 15 July 2004

[313] Wit, Joel. Daniel Poneman, and Robert Gallucci. The First North Korean Nuclear Crisis: Going Critical. Brookings. 2004

[314] Wit, Joel. Daniel Poneman, and Robert Gallucci. The First North Korean Nuclear Crisis: Going Critical. Brookings. 2004

[315] R. Jeffrey Smith, "U.S. Analysts Are Pessimistic on Korean Nuclear Inspection," Washington Post, 3 December 1993.

After satellites had discovered a plant in Yongbyon capable of producing weapons-grade plutonium, the Pentagon spent most of the first half of 1993 planning a war on the Korean peninsula. In 1994, US President Bill Clinton considered bombing the Yongbyon nuclear reactor, but later dismissed this option when he was advised that if war broke out, it could cost 52,000 US and 490,000 South Korean military casualties in the first three months, as well as a large number of civilian casualties. Those estimates were probably low. General Gary Luck, estimated possible casualties of one million, including 52,000 US military dead. Most of these casualties would have been in Seoul, which is perilously close to as many as 13,000 North Korean artillery pieces on the border. [316] Reality would have been worse.

The Clinton Divergence:
The US believed it would 'undoubtedly win' a war with North Korea in 1994 – but with enormous casualties. Besides, other than Yongbyon, the US had no idea concerning the whereabouts of additional targets related to Pyongyang's plutonium program, and would not begin to suspect that North Korea had a uranium program, until the North's nuclear negotiators admitted it – in October 2002. So much for intelligence. It is unlikely that any but the topmost officials of the ROK government and US military on the peninsula knew anything about the intended war. It may have been planned as a unilateral action with no ROK involvement until after the conflict began.

Had Clinton attacked the North in 1994, he might have bitten off more than he could chew. Even a few crude uranium weapons set off in South Korean and Japanse harbors would have likely ended such a conflict in North Korea's favor. Despite the eight-year nuclear freeze under the Geneva Agreed Framework, continuous IAEA and DOE monitoring of the Yongbyon nuclear facilities, and DPRK-KEDO cooperation in New York and Kumpo, questions remained unanswered. 1994 would become however, more memorable as the first year of North Korea's mass starvation, the Arduous March or, the March of Suffering.

The Arduous March:
The Arduous March, was a period of mass starvation that followed the collapse of the Soviet Union in 1991. The generally accepted timeframe of the famine is 1994 to 1998. It is one of the central events in the history of North Korea, and it forced the regime and its people to change in fundamental and unanticipated ways.

The famine is reported to have stemmed from a variety of factors. Economic mismanagement and the loss of Soviet support caused food production and imports to decline rapidly. A series of natural floods and droughts exacerbated the crisis. The North Korean government and its centrally planned system was assessed as too inflexible to effectively curtail the disaster.

Estimates of the death toll vary widely. Out of a total population of approximately 22 million, somewhere between 240,000 and 3,500,000 North Koreans died from starvation or hunger-related illnesses with deaths peaking in 1997.

The country was never self-sufficient in food, and many experts considered its *juche* ideology in the agricultural sector of the economy, to be unrealistic, and a contributing factor in starvation that followed. Due to North Korea's geography, farming is mainly concentrated among the flatlands of the four western coastal provinces. Along with western coastal provinces, fertile land also runs through the eastern seaboard provinces. However interior provinces such as Chagang and Ryanggang are mountainous, cold and do not receive enough rainfall to support farming.

Economic decline and failed policies provided the context for the famine, but the floods of the mid-1990s were the immediate cause. The floods in July and August 1995 were described as being "of biblical proportions" by independent observers. They were estimated to affect as much as 30 percent of the country

In the late 1980s, the Soviet Union was embarking on political and economic reform. To stabilize its command economy and convert the nation to a market economy, the USSR began demanding payment from North Korea for past and current aid, in currency – amounts North Korea could not repay. Barter was no long sufficient as a form of trade, especially in crudely produced consumer goods. In 1990 the North Korean economy then spun into negative growth. By 1991, the Soviet Union dissolved, ending all aid and support by trade concessions, such as cheap oil.

[316] Gusterson, Hugh. Paranoid, Potbellied Stalinist Gets Nuclear Weapons. How the U.S. Print Media Cover North Korea. Nonproliferation Review. Vol. 15, No. 1. March 2008

Without Soviet aid, the flow of imports to the North Korean agricultural sector ended, and the mechanisms that made up the North Korean government were too inflexible to respond. Energy imports fell by 75%. The economy went into a downward spiral, with imports and exports falling in tandem. Flooded coal mines required electricity to operate pumps, as the shortage of coal worsened, the shortage of electricity also increased., North Korea then fell into a vicious positive feedback loop, as a failing infrastructure cut coal production and floods diminished hydroelectric production capacity and their ability to transport energy via power lines, truck and rail, or did it? Despite such an apparent calamity, calamity it did not stop it from producing enriched uranium. Agriculture reliance on electrically-powered irrigation systems, artificial fertilizers and pesticides was hit particularly hard by the economic collapse.

Most North Koreans had experienced nutritional deprivation long before the mid-1990s. The country had once been fed with a centrally planned economic system that overproduced food, had long ago reached the limits of its productive capacity, and could not respond effectively to exogenous shocks.

Without the help from these countries, North Korea was unable to respond adequately to the coming famine. For a time, China filled the gap left by the Soviet Union's collapse and propped up North Korea's food supply with significant aid. By 1993, China was supplying North Korea with 77 percent of its fuel imports and 68 percent of its food imports. Thus, North Korea replaced its dependence on the Soviet Union with dependence on China – with predictably dire consequences. In 1993, China faced its own grain shortfalls and need for hard currency, and it sharply cut aid to North Korea.

The major issues created by the floods were not only the destruction of crop lands and harvests, but also the loss of emergency grain reserves, because much of the country's reserves were stored underground. According to the United Nations, the floods of 1994 and 1995 destroyed around 1.5 million tons of grain reserves, and the Centers for Disease Control and Prevention stated that 1.2 million tons (or 12%) of grain production was lost in the 1995 flood. There were further major floods in 1996 and a drought in 1997.

The country soon implemented austerity measures, dubbed the "eat two meals a day" campaign. These measures proved inadequate in stemming the economic decline. Personal stocks, hidden by each family; often an entire village, were soon absorbed and went un-replenished. Unofficially, the North Korean government had worked these personals stockpiles into the state's long-term planning. It has expected these hidden stockpiles to sustain the country's populace for about one year. Always tightly controlled, North Korean personal food caches were never that large and vastly overrated in government statistics. North Korea is known through the 1980s of maintain an on-hand wartime food storage supply sufficient for five year's operation. If the Sinanju Munitions Plant had begun full operations in 1986 or 1987, and crops failed, they would have begun running out of food in 1992 or 1993, right on schedule. By 1994 they were receiving outside food aid. While planning was extensive and concise, no planning can control the weather.

In 1995, devastating floods ravaged the country, arable land, harvests, grain reserves, and social and economic infrastructure were destroyed. The United Nations Department of Humanitarian Affairs reported that "between 30 July and 18 August 1995, torrential rains caused devastating floods in the Democratic People's Republic of Korea (DPRK). In one area, in Pyongsan County in North Hwanghae province, 877 mm of rain were recorded to have fallen in just seven hours, an intensity of precipitation unheard of in this area...water flow in the engorged Amnok (Yalu) River, which runs along the Korea/China border, was estimated at 4.8 billion tons over a 72 hour period. Flooding of this magnitude had not been recorded in at least 70 years." [317]

About 70% of power generated in the DPRK came from hydropower sources, and the serious winter-spring droughts of 1996 and 1997 (and a breakdown on one of the Yalu River's large hydro turbines) created major shortages throughout the country at that time, severely cutting back railway transportation (which was almost entirely dependent on electric power), which in turn resulted in coal supply shortages to the coal-fueled power stations which supplied the remaining 20% of power in the country. North Korea lost an estimated 85% of its hydroelectric power generating capacity due to flood damage to infrastructures such as planta, and supply and transport facilities. UN

[317] UN Department of Humanitarian Affairs. "United Nations Consolidated UN Inter-Agency Appeal for Flood-Related Emergency Humanitarian Assistance to the Democratic People's Republic of Korea (DPRK). 1 July 1996-31 March 1997." April 1996

officials reported that the power shortage from 1995 to 1997 was not due to a shortage of oil, because only two out of a total of two dozen power stations were dependent on heavy fuel oil for power generation... and these were supplied by KEDO. None of this however, was true, but it became the accepted story. It was convenient.

Humanitarian assistance to North Korea began in early 1990, with small-scale support from religious groups in South Korea and assistance from UNICEF. In August 1995, North Korea made an official request for humanitarian aid and the international community responded.

In 1996 the US began shipping food aid to North Korea through the United Nations World Food Program (WFP) to combat the famine. Shipments peaked in 1999 at nearly 600,000 tons making the US the largest foreign aid donor to the country at the time. Under the Bush Administration, aid was drastically reduced year after year from 320,000 tons in 2001 to 28,000 tons in 2005. The Bush Administration was criticized for using "food as a weapon" during talks over the North's nuclear weapons program, but insisted the US Agency for International development (USAID) criteria were the same for all countries and the situation in North Korea had "improved significantly since its collapse in the mid-1990s." The Bush Administration should have used food aid as a weapon, curtailing North activities at Korea's uranium- and plutonium-production with any means possible. In hindsight, USAID, the World Food Program, UNICEF and others relieved the North Korean government of its responsibility to for the welfare of its people, allowing the Pyongyang to build its bomb(s). Had starvation increased, the North Korean government would have been faced at some point in redirecting its resources into supporting the needs of its people, or have been overthrown but it would not have had a nuclear weapon.

South Korea (before the Lee Myung-bak government) and China remained the largest food donors to North Korea. The US objected to this manner of donating food, due to the North Korean state's refusal to allow donor representatives to supervise the distribution of their aid inside North Korea. Such supervision would ensure that aid was not seized and sold by well-connected local elites, or diverted to feed North Korea's large military. In 2005, South Korea and China together provided almost 1 million tons of food aid, each contributing half.

Humanitarian aid from North Korea's neighbors has been cut off at times in order to provoke North Korea into resuming boycotted talks. For example, South Korea decided to "postpone consideration" of 500,000 tons of rice for the North in 2006, but the idea of providing food as a clear incentive (as opposed to resuming "general humanitarian aid") has been avoided. There have also been aid disruptions due to widespread theft of railway cars used by mainland China to deliver food relief. Food aid was actually paying for North Korea's bomb program.

In September 2004, as progress on North Korea's plutonium weapon began to bear fruit, the Pyongyang government began restricting many humanitarian activities, particularly those of resident relief organizations, such as the WFP, and American NGOs operating in North Korea. The North Korean government did not permit the WFP access to many counties to assess needs, provide food, and monitor distribution. Initially, Anju County was off-limits of for foreigners involved with food aid. Over time, DPRK authorities opened more counties to the WFP. In 2004 North Korean authorities closed off several counties to UN humanitarian agencies, told the WFP it would have to reduce its expatriate monitoring presence by one-third (from fifteen to ten officials), and began to deny more monitoring visit requests. By the summer of 2004, 42 counties – representing about 15% of the population – were off limits, down from 61 in 1998. Aid reached Anju but, there are no reports of food aid ever reaching Sinanju. No food aid representatives ever entered the valleys holding the Sinanju Munitions Plant.

No aid is ever mentioned as being delivered at Yongwon-ni in Kaechon-gun; Unhung-ni, Hwayang-ni, Taekyo-ni, Yongyon-ni, Ipsok-ni in Anju-gun and Unsori, Songchong-ni and Hanchon-ni in Pyongwon-gun. North Korea also announced it would no longer appeal for outside humanitarian assistance. In February and March 2005, North Korea began to relax some of its restrictions. The WFP was allowed to re-enter most of the counties that had been previously closed off. Due to western naivety, North Korea found that it could eat, and have its rice too. The NIE however, continued to loom in the back ground. The actual truth would have been harder to accept.

The Dark Place:
In August 1998, the New York Times disclosed through satellite imagery that North Korea was building an underground nuclear facility in Kumchangri, nearby the already well-known Yongbyon. Satellite images and other intelligence gathered at a site called Kumchang-ri, near North Korea's border with China, seemed to indicate that the North Koreans were building a secret nuclear reactor and reprocessing facility to replace those then under

international control. For months, intelligence agencies followed developments at the site, observing tunnels being dug, watching concrete being poured, looking for air shafts and cooling ponds for evidence it was indeed a nuclear facility. [318]

On 18 May 1999, a US Department of State team traveled to the Democratic People's Republic of Korea with the purpose of visiting the underground facility at Kumchang-ni. The visit took place on an exceptional basis at the invitation of the North Korea. The US team consisted of fourteen members, including relevant technical experts. After initial consultations with the North Korean authorities, the team began its visit to the site at Kumchang-ni on 20 May. The visit was completed the evening of 22 May. After reviewing data gathered from the visit with North Korean authorities, the US delegation departed the country on 24 May. [319]

The North Koreans allowed the delegation to conduct the visit "in the manner the US deemed necessary," as agreed in March between the two sides, to help remove suspicions about the site. After an initial orientation tour of the underground areas provided by the local official in charge, the US delegation spent the next two days underground in order to ensure that it covered all the underground areas. The US delegation crisscrossed those areas a number of times at a pace and according to a plan determined by the delegation, in consultation with the DPRK. The U.S. delegation saw no evidence of DPRK efforts to conceal any portion of the facility. [320]

Based on the data gathered by the US delegation and the subsequent technical review, the US concluded that, at present, the underground site at Kumchang-ni does not violate the 1994 Geneva US-DPRK Agreed Framework. New construction of graphite-moderated reactors and related facilities in North Korea would be a violation of the Framework. [321] The inspection cost the US 300 million dollars in food aid, mostly potatoes. [322] There should have never been any excitement about Kumchang-ni, it bore few signatures that would have supported its identification as a nuclear reactor. Mostly, it lacked the clean pure water resources required to support a nuclear reactor or uranium enrichment facility. It was tied to the local sub-distribution grid at a low-level but not to the provincial distribution- or national-level grid. Most important, it lacked rail support. There were no steam plants, little concrete mixing and so on. It was a lemon.

The Defense Intelligence Agency made an "early assessment that this was happening and there was no other explanation for it," said Charles "Jack" Pritchard, a former Army intelligence official who served as the deputy head of North Korea negotiating team. The Defense Intelligence Agency's adamant conclusion "turned up in the New York Times before we were ready," Pritchard recounted, referring to an August 1998 Page 1 story. That report put political pressure on the Clinton administration, already under fire for failing to press North Korea. It demanded access to the site, going to the brink of renewed confrontation. [323]

Whatever its merits, the estimate foreshadowed future polarization (amid the IC and policymakers) between those projecting the worst case and those inclined to leave more room for other possibilities. Within the IC, the starkest divisions were reportedly between the State Department's Bureau of Intelligence and Research (INR) (which dissented from the estimate's judgments) and the Defense Intelligence Agency (DIA), which (according to a 3 December 1993 Washington Post article) was already judging that "North Korea will continue its nuclear weapons program despite any agreement it signs to the contrary." [324] This disagreement would continue on to the present-day with policymakers continuing to ignore the problem.

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318 Lewis, Jeffrey. David Sanger: Two Time Losers on Kilju And Kumchang-Ri? Arms Control Wonk. 21 May 2005. https://www.armscontrolwonk.com/archive/200598/david-sanger-two-time-loser-on-kilju-and-kumchang-ri/

319 Report on the U.S. Visit to the Site at Kumchang-Ni, Democratic People's Republic of Korea. U.S. Department of State. Office of the Spokesman. Press Statement by James P. Rubin, Spokesman. 25 June 1999. https://1997-2001.state.gov/briefings/statements/1999/ps990625a.html

320 Report on the U.S. Visit to the Site at Kumchang-Ni, Democratic People's Republic of Korea. U.S. Department of State. Office of the Spokesman. Press Statement by James P. Rubin, Spokesman. 25 June 1999. https://1997-2001.state.gov/briefings/statements/1999/ps990625a.html

321 Report on the U.S. Visit to the Site at Kumchang-Ni, Democratic People's Republic of Korea. U.S. Department of State. Office of the Spokesman. Press Statement by James P. Rubin, Spokesman. 25 June 1999. https://1997-2001.state.gov/briefings/statements/1999/ps990625a.html

322 N. Korea: Nukes for Potatoes. CBS News. 16 March 1999. https://www.cbsnews.com/news/n-korea-nukes-for-potatoes/

323 Lewis, Jeffrey. David Sanger: Two Time Losers on Kilju And Kumchang-Ri? Arms Control Wonk. 21 May 2005

324 Albright and O'Neil, Solving the North Korean Nuclear Puzzle. The International Institute for Strategic Studies (IISS). Washington D.C.

Perry's Black Ships:
In late May 1999, something quite extraordinary happened. An official plane bearing the blue-and-white markings of the US government and emblazoned with the stars and stripes landed and taxied along the runway of Pyongyang's Miram Airport. The aircraft was carrying a former defense secretary, William Perry, who had been brought in from retirement by President Bill Clinton to try to end the frozen conflict between the US and North Korea. The flightpath followed by Perry's plane, which had taken off in Japan, had not been used since the Korean war. [325]

Perry was arriving at a moment of high tension. The previous year, the regime in Pyongyang had shown off its proficiency in missile technology with a series of tests, including the launch of a long-range Taepodong-1, which sailed over Japan before splashing into the Pacific. Officially, the Taepodong-1 was intended to launch a satellite, but it relied on the same technology as an intercontinental ballistic missile. And the only way such a missile is of real military use is when it has a nuclear warhead in its nose cone. [326]

By the time the Perry arrived in Pyongyang, the 1994 Geneva Agreed Framework between Washington and Pyongyang, intended to prevent North Korea from ever becoming a nuclear weapons state, was fraying. Both sides were failing to deliver on their earlier promises. Perry was carrying a letter from Bill Clinton to the North Korean dictator, Kim Jong-il, who had inherited power in 1994 after the death of his father, Kim Il-sung, the founder of the nation and its ruling dynasty. Along with Clinton's letter to Kim expressing hope for better relations, Perry carried an explicit mandate from Japanese and South Korean leaders, authorizing him to speak on their behalf, and the outline of a peace plan. In return for a broad renunciation of nuclear weapons and long-range missiles, North Korea would get more than oil and reactors – it would get a ticket back into the international community, including diplomatic ties and trade with the US. One of Perry's aims in travelling to Pyongyang in 1999 was to see if diplomacy with North Korea was even a possibility. [327]

For Perry, the flight to Pyongyang and the exchanges that followed over the next 18 months represented one of the great might-have-beens of diplomatic history, which – had it been allowed to reach its conclusion – could have set North Korea and the wider region on a much less dangerous path. [328] Much of Perry's short stay in Pyongyang was spent with the regime's top "neck-tie," Kang Sok-ju, a tough, often prickly diplomat, who was known as a confidant of Kim Jong-il. In a series of meetings, which were punctuated by speeches about US perfidy and the virtues of the Kim family leadership, Kang would listen to the Americans' proposals and come back the next day with questions. Perry assumed that after each encounter Kang was consulting with Kim Jong-il and then relaying the leader's queries. [329]

Perry's delegation was wined and dined, taken to see the country's top acrobats perform, and given a tour of Pyongyang. They visited the *Juche* Tower, a stone edifice erected in honor of the state ideology of self-reliance. They also toured a collective farm to see a rice-planting device said to have been invented by the leader, moved by the plight of his famished people. [330]

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[325] Borger, Julian. Two minutes to midnight: Did the US miss its chance to stop North Korea's nuclear programme? 30 Mar 2018. https://www.theguardian.com/news/2018/mar/30/north-korea-us-nuclear-diplomacy-agreed-framework-1999-pyongyang-mission
[326] Borger, Julian. Two minutes to midnight: Did the US miss its chance to stop North Korea's nuclear programme? 30 Mar 2018. https://www.theguardian.com/news/2018/mar/30/north-korea-us-nuclear-diplomacy-agreed-framework-1999-pyongyang-mission
[327] Borger, Julian. Two minutes to midnight: Did the US miss its chance to stop North Korea's nuclear programme? 30 Mar 2018. https://www.theguardian.com/news/2018/mar/30/north-korea-us-nuclear-diplomacy-agreed-framework-1999-pyongyang-mission
[328] Borger, Julian. Two minutes to midnight: Did the US miss its chance to stop North Korea's nuclear programme? 30 Mar 2018. https://www.theguardian.com/news/2018/mar/30/north-korea-us-nuclear-diplomacy-agreed-framework-1999-pyongyang-mission
[329] Borger, Julian. Two minutes to midnight: Did the US miss its chance to stop North Korea's nuclear programme? 30 Mar 2018. https://www.theguardian.com/news/2018/mar/30/north-korea-us-nuclear-diplomacy-agreed-framework-1999-pyongyang-mission
[330] Borger, Julian. Two minutes to midnight: Did the US miss its chance to stop North Korea's nuclear programme? 30 Mar 2018. https://www.theguardian.com/news/2018/mar/30/north-korea-us-nuclear-diplomacy-agreed-framework-1999-pyongyang-mission

Over their four days in Pyongyang, Kang and the other North Koreans had listened and asked questions, but made no counter-offers. The Americans were politely thanked for the visit and were told to expect a response. There was no immediate sense of breakthrough. The demeanor and constant hectoring of the North Koreans left no doubt the mission had been a failure. However, the North Koreans didn't say no, and by their terms that was a near endorsement. It was more than a year before the North Koreans signaled, they were ready to resume the talks with a return visit. [331] In the background, the North Korea uranium enrichment facilities hummed along at the Sinanju Munitions Plant.

High Noon:
In June 2000, just over a year after Perry's trip and almost exactly 50 years after the outbreak of the Korean war, the leaders of North and South Korea met for the first time. South Korean president Kim Dae-jung had survived kidnapping, an assassination attempt and a death sentence under the US-backed South Korean dictatorship in the 70s and 80s. His rise to the presidency in 1998 marked a decisive break with the country's past, including its policy of hard-edged containment of the North. [332]

Kim Dae-jung argued for a "sunshine policy" of detente with Pyongyang. In an exceptional political gamble, he flew to the North Korean capital, not knowing what kind of reception awaited him. At the end of the trip, the leaders declared their commitment to the reunification of the peninsula "through the joint efforts of the Korean people." This heady language created a sense of optimism that peace might now be possible. Kim Dae-jung was awarded the Nobel peace prize a few months later for his efforts. Now that relations had been restored with Seoul, the North Korean leader was finally ready to pursue the negotiations with the US that Perry had begun the previous year. [333]

In October 2000, Kim dispatched one of his top military officers, the 72-year-old war veteran Vice Marshal Jo Myong-rok, to Washington. Along the way, Jo stopped in California, where Perry held a dinner for him at Stanford University and took him on a tour of tech companies around San Francisco Bay, a personal request from Kim Jong-il. In Washington, however, the old general staged a surprise. Just before going to the White House, Jo went to his hotel to change from his business suit into full dress uniform, complete with rows of medals. At the end of Jo's trip, the two governments issued a joint statement, which was a more optimistic view of the relationship than anything before or since. Nine days after Jo's visit, in what was probably one of the odder moments in North Korean history, US Secretary of State, Madeleine Albright hurried to Pyongyang to finalize the deal and lay the groundwork for a presidential visit from Bill Clinton. North Korean officials bent over backwards to make sure her visit was a success. [334] Clinton would only ever meet Kim Jong-il after he left office. Ignoring North Korea after the 1994 Geneva Agreed Framework, at least Clinton could boast that there hadn't been a 2nd Korean War on his watch, not on his watch. Clinton's North Korean legacy is however, one that might one day lead to a war of total annihilation.

Getting North Korea to agree to strict missile curbs was the key objective of the Albright visit, and she made it clear to Kim that she could not recommend a visit by Clinton until Kim could dispel US concerns. Albright returned from Pyongyang convinced that Kim Jong-il was a pragmatist, and that a presidential visit would put the seal on a historic deal. However, the view of the Bush hawks was that the Clinton administration's contact with Pyongyang represented a reward for the regime's human-rights atrocities and violations of arms agreements. At the time, US

[331] Borger, Julian. Two minutes to midnight: Did the US miss its chance to stop North Korea's nuclear programme? 30 Mar 2018. https://www.theguardian.com/news/2018/mar/30/north-korea-us-nuclear-diplomacy-agreed-framework-1999-pyongyang-mission
[332] Borger, Julian. Two minutes to midnight: Did the US miss its chance to stop North Korea's nuclear programme? 30 Mar 2018. https://www.theguardian.com/news/2018/mar/30/north-korea-us-nuclear-diplomacy-agreed-framework-1999-pyongyang-mission
[333] Borger, Julian. Two minutes to midnight: Did the US miss its chance to stop North Korea's nuclear programme? 30 Mar 2018. https://www.theguardian.com/news/2018/mar/30/north-korea-us-nuclear-diplomacy-agreed-framework-1999-pyongyang-mission
[334] Borger, Julian. Two minutes to midnight: Did the US miss its chance to stop North Korea's nuclear programme? 30 Mar 2018. https://www.theguardian.com/news/2018/mar/30/north-korea-us-nuclear-diplomacy-agreed-framework-1999-pyongyang-mission

intelligence had substantial evidence that the regime was pursuing a covert uranium program, but that did not stop the Albright mission. [335]

In his January 2002 State of the Union address, the first since the 11 September 2001 attacks, President Bush grouped North Korea into an "axis of evil," along with Iraq and Iran. The speech emphasized the idea that the United States "must not permit the world's most dangerous regimes to threaten us with the world's most destructive weapons." In contrast to statements about use of force in Iraq, however, in a February 2002 speech in Seoul, President Bush said that the United States had no intention of invading North Korea and was supportive of the South Korean President's "sunshine policy" that emphasized engagement. [336] The United States and North Korea scheduled talks for summer 2002, but they were postponed after a 29 June 2002, naval skirmish between North and South Korea in which 19 South Korean troops were killed along the Northern Limit Line.

An Inadvertent Disclosure:

A Japan-North Korea Summit in September 2002, between Prime Minister Junichiro Koizumi and Kim Jong-il, raised hopes for resolution to this and other issues. North Korea renewed its commitment to a missile testing moratorium in September 2002, in advance of a high-level visit to Pyongyang by US diplomats. However, a new crisis began in October 2002. During a visit to Pyongyang, then-Assistant Secretary of State for East Asian and Pacific Affairs James A. Kelly reportedly presented the North Koreans with evidence of a clandestine HEU production program in North Korea.

Confronted by US negotiators that North Korea had a clandestine uranium enrichment program in addition to its declared plutonium-based nuclear operation, North Korea admitted it, and then began to backtrack. The North Korean admission led to the breakdown of a 1994 Geneva Agreed Framework, which has now been superseded by a multi-lateral disarmament deal. The New York Times said two unnamed US administration officials suggested that if Washington had harbored the same doubts when it leveled the accusation in 2002 as it does now, the negotiating strategy with North Korea might have been different. [337] Negotiations then collapsed. On 25 October 2002, North Korea issued a statement saying that it was entitled to possess nuclear weapons. Had Bush and administration policymakers absolutely demanded answers, there would have been no doubts that North Korea had a uranium-based weapon.

On 29 November 2002, the IAEA Board of Governors passed a resolution calling on North Korea to clarify reports of a uranium enrichment program and come into compliance with its safeguard's agreement. The resolution stated that "any other covert nuclear activities would constitute a violation of the DPRK's international commitments, including the DPRK's safeguards agreement with the Agency pursuant to the NPT." More words had now been moved around the room. On 14 November 2002, KEDO board members also determined that the hidden program (location unknown) was a violation of the Geneva Agreed Framework and decided to halt fuel oil shipments to North Korea beginning in December 2002. KEDO said that, "Future shipments will depend on North Korea's concrete and credible actions to dismantle completely its HEU program." The already uneasy US-DPRK relationship shifted into one of hostility.

Beginning in August 2003, negotiations over North Korea's nuclear weapons programs involved six governments: The United States, North Korea, China, South Korea, Japan, and Russia. The meetings then became known as the Six-Party Talks. The Second Round of talks began on 25 February 2004. These negotiations stalled almost immediately, particularly after the US Treasury Department's September 2005 designation of Banco Delta Asia (BDA), a bank in the Chinese territory of Macau, as a financial institution of primary money laundering concern due to suspected counterfeiting. [338]

The Nuclear Saloon:

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[335] Borger, Julian. Two minutes to midnight: Did the US miss its chance to stop North Korea's nuclear programme? 30 Mar 2018. https://www.theguardian.com/news/2018/mar/30/north-korea-us-nuclear-diplomacy-agreed-framework-1999-pyongyang-mission

[336] The American Presidency Project. University of California. Santa Barbara, "George W. Bush: Remarks at the Dorasan Train Station in Dorasan, South Korea." 20 February 2002, and The White House, "President Bush & President Kim Dae-Jung Meet in Seoul," press release, 20, February 2002

[337] US uncertain about North Korean uranium programme. New York Times. 02 Mar 2007

[338] US Department of State, "Joint Statement of the Fourth Round of the Six-Party Talks, Beijing," 19 September 2005, https://www.state.gov/p/eap/regional/c15455.htm

On 10 February 2005, North Korea announced officially that it has developed nuclear weapons and that it was debating a return to the six-party talks, but only if certain criteria were met. It said it had reprocessed 8,000 fuel rods, turning them into weapons fuel. Specialists inside and outside the government say thr fuel could be used to produce six or more nuclear weapons, but there is no independent evidence to confirm that the weapons have been produced.

In March 2005, the Commission on the Intelligence Capabilities of the United States Regarding Weapons of Mass Destruction (WMD), which convened beginning in 2004 to investigate the failed 2002 national intelligence estimate on Iraqi WMD capabilities, indicated that we know "disturbingly little about the weapons programs and even less about the intentions of many of our most dangerous adversaries," presumably including North Korea. [339]

Negotiations resumed at the end of July 2005; the talks concluded with no agreement. During those negotiations, the United States presented to North Korea evidence that the North Koreans clandestinely procured uranium enrichment technology from the A.Q. Khan network. American officials shared the intelligence with North Korea to convince Pyongyang that disarmament discussions must include the uranium weapons program it has touted, but also a program that it now said does not exist. [340] Senior administration intelligence officials told reporters in 2005 that any agreement must include dismantling both programs but, those same officials have said they do not know the location of North Korea's the uranium program. [341] "We don't want to be inspecting every tunnel where it might be hidden," the senior official said. "They've got to give it up. That's how the Libyans did it." [342] That was 15 years ago now, perhaps they should have done the inspecting.

American officials have never made public the details of Mr. Khan's statements to Pakistani officials, who have declined to make him available for direct interrogation. But they have shared the information widely with Asian allies, and elements of it have leaked out, including Mr. Khan's assertion – doubted by several specialists in the American IC – that the North Koreans once showed him what they said were three fully assembled nuclear weapons. [343] It is more likely that they did indeed show him such an arsenal. Anything more than one weapon is a restrike capability.

Nuclear Tests:
North Korea tested a plutonium device in October 2006. Many argued that its first test was a failure, that was only true however, if the country's scientists failed to learn anything from the event. It is clear that North Korea learned a lot from each of these tests as its final test in 2017 would show.

As the Six-Party Talks resumed in February 2007 and, as the US IC continued to flounder in its efforts to locate North Korea's uranium enrichment program failed, US officials acknowledged that their confidence in intelligence judgments about Pyongyang's uranium capabilities had declined. [344] What is known about North Korea's nuclear program – is mostly what Pyongyang wants us to know. At most, North Korea simply manages US perceptions. Intelligence assessments during this time continued to highlight concerns about North Korea's program, but they still did not directly conclude that Pyongyang was developing nuclear weapons.

By early 2007, official assessments had throttled back still more. Again, Arms Control Today had the story:

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[339] Report of the Commission on the Intelligence Capabilities of the United States Regarding Weapons of Mass Destruction, cover memo. https://www.gpo.gov/fdsys/pkg/GPO-WMD/content-detail.html
[340] Sanger, David E. and Jim Yardley. "U.S. Offers N. Korea Evidence that Nuclear Secrets Came from Pakistani's Network." New York Times Online News Service. 28 July 2005. https://www.nytimes.com/2005/07/29/politics/us-offers-north-korea-evidence-that-nuclear-secrets-came-from.html
[341] Sanger, David E. and Jim Yardley. "U.S. Offers N. Korea Evidence that Nuclear Secrets Came from Pakistani's Network." New York Times Online News Service. 28 July 2005. https://www.nytimes.com/2005/07/29/politics/us-offers-north-korea-evidence-that-nuclear-secrets-came-from.html
[342] Sanger, David E. and Jim Yardley. "U.S. Offers N. Korea Evidence that Nuclear Secrets Came from Pakistani's Network." New York Times Online News Service. 28 July 2005. https://www.nytimes.com/2005/07/29/politics/us-offers-north-korea-evidence-that-nuclear-secrets-came-from.html
[343] Sanger, David E. and Jim Yardley. "U.S. Offers N. Korea Evidence that Nuclear Secrets Came from Pakistani's Network." New York Times Online News Service. 28 July 2005. https://www.nytimes.com/2005/07/29/politics/us-offers-north-korea-evidence-that-nuclear-secrets-came-from.html
[344] Kerr, Paul. News Analysis: Doubts Rise on North Korea 's Uranium-Enrichment Program. ARMS CONTROL TODAY. 2007. https://armscontrol.org/act/2007-04/news-analysis-doubts-rise-north-korea-s-uranium-enrichment-program

> "A senior US intelligence official confirmed in early March that Washington has become less confident than it was in October 2002 that Pyongyang is continuing to pursue an enrichment program. Ambassador Joseph DeTrani, North Korean mission manager for the Office of the Director of National Intelligence, said in a March 4 statement that all US intelligence agencies 'have at least moderate confidence that North Korea's past efforts to acquire a uranium enrichment capability continue today.' By contrast, the US intelligence community had ''high confidence" in 2002 that North Korea was attempting to acquire a uranium enrichment capability." [345]
>
> After in-depth intelligence reviews "Few believe anymore that North Korea developed a program to produce highly enriched uranium for use in nuclear weapons."
>
> North Korea's Plutonium Declaration: A Starting Point for An Initial Verification Process by David Albright, Paul Brannan, And Jacqueline Shire. The Institute for Science and International Security. 10 January 2008

That the world's intelligence communities could not identify such facilities meant they must not exist. It was a strange conclusion based upon an unwillingness to do the work required to find the answers, and a disinclination of the policymaking community to accept bad news.

> "North Korea said Friday that it is in the final stages of enriching uranium, a process that could give the nation a second way to make nuclear bombs in addition to its known plutonium-based program."
>
> Joshua Stanton "North Korea's Uranium Enrichment: Raising the Stakes," 4 September 2009

Obviously not.

Then the issue became political.

Power at all costs:
In 2007 Democrats began to press the Bush administration to explain the growing uncertainty surrounding past US allegations about a secret North Korean uranium enrichment program. Bush was accused of overstating the facts about North Korea's program. If anything, bureaucrats loyal to Clinton had downplayed the threat posed by North Korea and left President Bush uninformed.

Unlike Clinton, who did not want to know about North Korean nuclear violations of the Agreed Framework, after 9-11 and Bush's response, no one would tell the president the cold hard facts. Worse yet, none of the bureaucrats even knew the cold hard facts. Five former senior US intelligence and diplomatic officials who were involved in the issue told McClatchy Newspapers that the US knew that North Korea had bought nuclear equipment from Pakistan and elsewhere. But they said it was never certain whether the North Koreans had managed to assemble what they'd bought into a working uranium enrichment program. [346] "We knew that they'd bought a lot of stuff to enrich uranium," said one former senior official, who like the others requested anonymity because intelligence on North Korea's nuclear program is highly classified. "But we still aren't sure what, if anything, they've done with it." [347] Perhaps they had purchased the uranium enrichment equipment to enrich uranium?

According to Christopher Ford writing his is blog sponsored by the Hudson Institute: "To judge from their behavior, *their* reaction was one of horror, and of grim determination to prevent "those people" (*i.e.*, Bush Administration political appointees) from acquiring any further proliferation-related *causus belli* anywhere in the world. At least inside State, at any rate, the bureaucrats closed ranks in an effort to preclude finding proliferation threats in other potential "future Iraqs." Their behavior, in a sense, was thus precisely analogous to that of IAEA Director General Mohammed ElBaradei, who later admitted that he had come to see himself as the world's "secular pope," doing "God's work" in order to prevent "crazies" (in the United States, he did not need to add) from having any excuse for war. As with ElBaradei's approach to the nuclear problems that developed with Iran after August 2002, civil and

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345 Kerr, Paul. News Analysis: Doubts Rise on North Korea 's Uranium-Enrichment Program. ARMS CONTROL TODAY. 2007. https://armscontrol.org/act/2007-04/news-analysis-doubts-rise-north-korea-s-uranium-enrichment-program
346 LANDAY, JONATHAN S. Administration asked to clarify intelligence on North Korea. MCCLATCHY NEWSPAPERS. 02 MARCH 2007, UPDATED 25 MAY 2007. https://www.mcclatchydc.com/latest-news/article24461482.html
347 LANDAY, JONATHAN S. Administration asked to clarify intelligence on North Korea. MCCLATCHY NEWSPAPERS. 02 MARCH 2007, UPDATED 25 MAY 2007. https://www.mcclatchydc.com/latest-news/article24461482.html

foreign service officials within State let their determination to stymie the Bush Administration lead them far down the path of politicization and manipulative disingenuousness."[348] Ford had more to say.

"The State Department's "attorney-advisers" one of whom in 2004 proudly told British diplomat David Landsman in my presence that he considered it his job not just to offer legal advice but to take *policy* positions absolutely refused to countenance making any public challenge to Iran's legal arguments." Wanting to believe the best about North Korea and ignoring the facts endangers the country. It has indeed defeated the intentions of those who fought for an intelligence community in the aftermath of WWII using the argument in a now nuclear world "No More Pearl Harbors." President Truman who signed the National Security Act of 1947 though he disagreed with it had been right; it had eventually become a state-within-a-state, a Gestapo without hobnailed boots, black uniforms in business suits. Bureaucrats are not elected to make decisions, the president is. They had no right to be deciding policy or the nature of US national security. They had exceeded the power an authority granted them. Yet, to date, none have called this treason.

The explosive US accusations in 2002 led to a political standoff with North Korea over its nuclear weapons program, but a US intelligence official said Tuesday the United States is now less certain about the uranium program's existence.

Democrats in Congress said the controversy harkens back to the administration's past reliance on flawed intelligence, citing the now discredited allegations that Saddam Hussein's Iraq was hiding weapons of mass destruction.

"This goes back to Iraq – and goes back to Iran," Senate Majority Leader Harry Reid told AFP. "It appears that there are some who are saying that the intelligence – even with North Korea – has been manipulated." It wasn't manipulation but apathy.

In 2009, North Korea shifted its policy away from the Six-Party Talks and toward a more concerted effort to develop its nuclear weapons capability. In April 2009 North Korea launched a long-range rocket. On 25 May 2009, North Korea announced that it had conducted a second nuclear test. The Obama Administration responded to the missile and nuclear tests by seeking United Nations sanctions against North Korea. It secured UN Security Council approval of Resolution 1874 in June 2009. The resolution called on UN members to restrict financial transactions in their territories related to North Korean sales of weapons of mass destruction (WMD) to other countries. It also called on UN members to prevent the use of their territories by North Korea for the shipment of WMD to other countries. In December 2009, the Administration sent a special envoy to North Korea in an attempt to secure North Korean agreement to return to the six party talks. North Korea gave a general positive statement regarding six party talks; but it raised other issues, including its proposal for negotiation of a US-North Korean peace treaty, and appeared to seek a continuation of bilateral meetings with the United States.

Under Kim Jong-un, who assumed power in after the death of his father in 2011, North Korea has rejected the idea of denuclearization outright and reaffirmed the role of nuclear weapons in national policy. Throughout 2011, the Obama Administration held secret bilateral discussions with North Korea in an attempt to return to denuclearization negotiations, while also pursuing steps to increase sanctions on Pyongyang. After Kim Jong-il died in December 2011, US officials were uncertain whether Kim's son and successor, Kim Jong-un, would agree to terms that had been discussed under his father. In the months after Kim Jong-un took power, the North Korean state consolidated its commitment to nuclear weapons development, eventually changing its constitution in May 2012 to say that it was a "nuclear-armed state." The Obama Administration focused on strengthening international sanctions through the UN Security Council, but also held several rounds of bilateral talks, anything but confrontation.

Between 2010 and 2017, North Korea conducted four nuclear tests (one in 2013, two in 2016, and one in 2017). In September 2017 North Korea conducted it fourth nuclear weapons test, estimated to have exceeded 100 kilotons in yield, suggesting North Korea has developed a thermonuclear or boosted fission device. Details and assessments of the test are murky and remain contentious. The US Geological Service put the magnitude of the seismic disturbance at 6.3 on the Richter scale, considerably higher than the tremors recorded in the country's past nuclear tests.

[348] Christopher Ford. Some Thoughts on How Not to do WMD Intelligence: Lessons of Politicization After Iraq. The Hudson Institute. 4 January 2010. https://www.hudson.org/research/9122-some-thoughts-on-how-not-to-do-wmd-intelligence-lessons-of-politicization-after-iraq

Independent seismic monitor NORSAR (Norwegian Seismic Array) estimates the latest test had a yield of as much as 120 kilotons. An official at the Korea Meteorological Administration said it was closer to 50. Over the same timeframe, North Korea conducted more than 80 missile tests, including several that demonstrate the country's ICBM capability of placing the US homeland under its nuclear umbrella.

In 2017, the DIA estimated that North Korea may possess as many as 60 nuclear weapons. If the facilities at the Sinanju Munitions Plant went operational in or around 1986, then the estimate is low. Irrational even. [349] North Korea achieved this impressive progress in its nuclear and missile programs despite ever increasing escalation of international sanctions, including six rounds of UN sanctions and gradually escalating US sanctions. It is unclear if North Korea has an operational nuclear arsenal that it could use in a war, or what delivery system it would rely upon to employ the weapon. It did however, in the late 1980s and early 1990s construct underground nuclear weapons storage bunkers in select sites around the country, dispersing its assets and preventing observation. As it stands now, nuclear weapons have become a symbol of the Kim regime's legitimacy and power.

The Misery of the Proletariat:
Despite the judgements and good intentions of many to excuse away the death of somewhere between 240,000 and 3,500,000 people, the Arduous March foreshadowed a conscious decision made by the North Korean leadership sometime in 1985 or 1986, to initiate intensive operations with its installed EMIS system. It was a known and accepted risk taken into account by the leadership of North Korea when they set the nation on its course to acquire a nuclear weapons capacity. To Kim Il-sung and Kim Jong-Il it was a matter of national, if not racial and cultural survival. Nothing else mattered. If it took the deaths of millions, so be it. It was not a result of floods or droughts; a failure of the nation's food distribution system or the country's geography. The Arduous March was a direct result of nothing more than North Korea's desire for a nuclear weapon.

Though no documents have been released that would testify to these events, there was undeniable evidence that something strange had taken place in the country in the mid-1980s and, it came straight from the North Korean government in the form of statistics concerning its electrical power. Short of being inside one of North Korea's actual uranium enrichment facilities, what appears below is the only actual evidence that uranium was being enriched north of the DMZ.

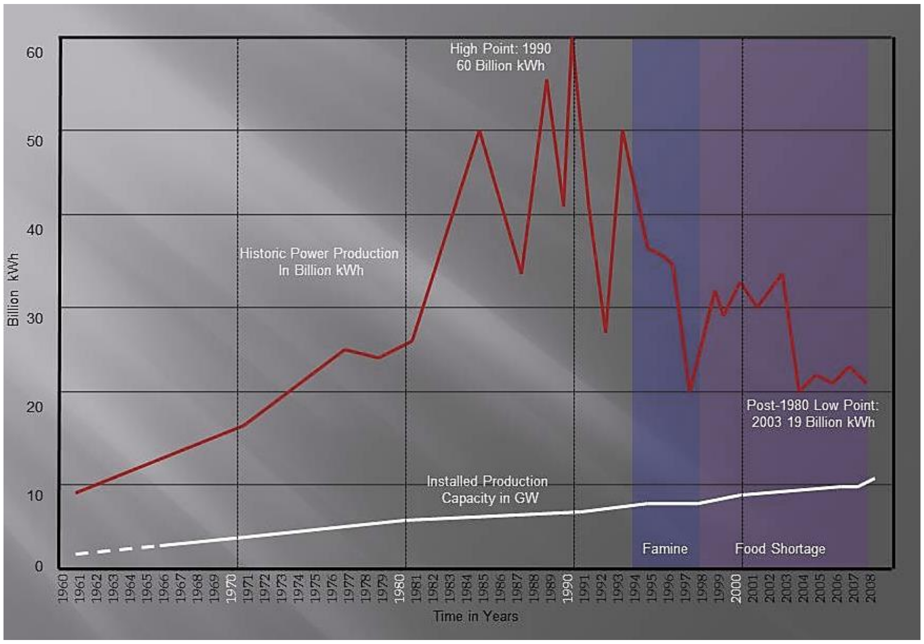
The graph below was produced from North Korean statistics release regarding the nation's electrical power production. Several different sets of statistics have been provided by North Korea and others, what might be called a higher set, a medium set, and a set of lower numbers, the graph below relies upon the higher numbers. Regardless of the set used, the general direction of the graph, the angles of its rise and fall, is generally the same. What the graph depicts is a steady climb in the production of electrical power generated nation-wide through about 1984, then a drastic drop around 1984 that would last until about 1988. The climb and drop coincides directly with the suspected operational startup of North Korea's EMIS. Everyone thought that North Korea's electric power system failed, it didn't.

If North Korea had installed an EMIS system, and had operated or tested it extensively, that would account for the erratic performance of its electrical power system before 1990. That North Korea had generated about 50 billion kilowatt hours of electricity before the 1984 drop in production, many concluded that the country's national grid was outdated, worn out, and collapsed. How they drew this conclusion is unknown. Historically, only a handful of national grids have ever collapsed, North Korea's was not one of those.

The national grid performed as required by North Korea's leadership. It was not industrial demand that had guided the use of North Korea's national grid, it was political demand. If it hadn't, North Korea wouldn't have a bomb.

[349] Warrick, Joby. Ellen Nakashima, and Anna Fifeld, "North Korea Now Making Missile-Ready Nuclear Weapons." Washington Post. 8 Aug 2017

Capital goods, tangible assets:
Electric power systems, major power stations, national-level grids and so on were capital goods, tangible assets that support the production of other goods by use of their initial product. Capital goods only fail due to a lack of maintenance or willful decision. North Korea's electrical power system was a victim of neither. The only failure, was the failure of North Korea's Third Seven-Year Plan to reach a generating capacity of 100 billion kWh by 1993.



They could not operate a full-scale EMIS program and support all the consumer needs of the North Korean population. A uranium enrichment program consists of nothing less than the total concentration of a nation's resources toward the accomplishment of a single goal. Sometime in 1989 or 1990, a second decision was required, Kim Il-sung or Kim Jong-Il made it. After 1993, the lights went out in Pyongyang and most of the remaining country, except for certain spots, one of those being the Sinanju Munitions Plant.

By 1990, according to North Korean statistics, their power system generated 60 billion kWh. The system was well on its way to generating the 100 billion demanded by the Third Seven-Year Plan then, production dropped. From its high in 1990 through 1992 production dropped to 27 billion kWh, then recovered somewhat. In 1992 production reached 50 billion kWh. In 1997, production had dropped to a low of 20 billion kWh, a slump equal to its high of 1973-1974. It would never recover again past 35 billion kWh. Oddly enough, over that same period of time, production capacity in MW grew. From 1976 to 2007, production capacity doubled and continues to grow to this day however, North Korea remains to this day, the Dark Kingdom. After 2003, South Korea began to supply some electrical power to the North Korean grid. In doing this, the ROK gained access to the North Koreans electrical power Supervisory Control and Data Acquisition (SCADA) system. Technically, the ROK had a curb side view into the North Korean SCADA, or did it?

A management system, SCADA operates by signals passed along electrical power lines from and to power plants, switchyards and transformer substations allowing operators and transmission control centers to monitor operations and conditions along the electrical power system. As a communications signal, the information can be changed, manipulated and managed at any transformer substation along the route. South Korea's window was either fogged, or it was not getting the entire picture. As the Nautilus Institute for Security and Sustainability would report (Napsnet) in 2011:

> "There is also a significant difference between the total installed capacity or amount of power generation that the plants in North Korea can produce and the actual annual electricity generation (kWh) of North Korean power plants. When we look at formal data from the Bank of Korea (BOK) after 2005 (see Table 1 below), the total installed capacity and generation in 2009 were reported to be 6,930 MW and 23.5 TWh, respectively, lower than the previous year of 2008." [350]

After 2005, the Bank of Korea now released power production statistics for North Korea. According to the ROK government, power generation across North Korea through 2008, never exceeded 25 billion kWh.

[350] "The DPRK Power Sector: Data and Interconnection Options", NAPSNet Special Reports, 9 August 2011, https://nautilus.org/napsnet/napsnet-special-reports/the-dprk-power-sector-data-and-interconnection-options/

The real problem was this; if North Korea had produced 60 billion kWh in 1990, and could only show a production of 23 billion kWh now, where was the other potential 37 billion kWh going? Keep in mind that from 1990 to the present, North Korea's production capacity was growing. It had doubled from 1976 to 2007. Production capacity would continue to grow through 2020. How could production capacity double, continue to grow, and yet actual production in kWh continue to decline? Why was North Korea continuing to invest in hydroelectric power through the construction of more dams and power stations if their actual production of electricity was continuing to decline? The Huichon Power Stations No. 1 and 2 had been completed. Hochongang Power Stations No. 1, 2, 3 and 4, and the Tanchon Power Station had been commissioned. There are many others. While these are likely medium-scale power station, why the continued investment in hydroelectric power if it adds nothing to the overall production of electricity in North Korea? The answer is that all this continued growth does add to North Korea's overall electrical power production. Where this production goes is another matter. Someone should ask.

While North Korea's move to small- and medium-scale hydroelectric power stations has been much noted over the past five years, even touted in some press as "Kim Jong-un's Green Agenda," it was anything but new. [351] Yes, North Korea was building many new small- and medium-scale hydroelectric power plants however, North Korea had been building numerous new small- and medium-scale hydroelectric power plants since the 1960s. Then it wasn't "Green," it was poor.

Bad timing and uncontrollable events:
Most of what happened in North Korea during the 1990s was actually the result of bad timing and uncontrollable events. Like Germany in August 1914, North Korea had developed a long-term plan to produce a uranium-based weapon and had set that plan in motion. After initiating the plan, events simply took a life of their own. The Fall of the Berlin Wall, the Collapse of the Soviet Union, were all events outside North Korea's control. North Korean industry did not collapse due to a lack of electric power, but due to a lack of consumer or foreign demand. Electric power is consumed as it is generated. There is a balance at work. No more power can be produced and placed online than can be taken offline at the same time. Any excess power produced, will be consumed by its generator. This principle would eventually become of extreme importance to the North Korea uranium enrichment program. North Korean industry had not shut down due of a lack of electrical power, it had shut down simply because it was incapable of consuming the electrical power produced. As the EMIS came online and consumed power, North Korea's industry's could not justify their continued existence.

Few Korea watchers could discern what had taken place or what it meant. It was a heady moment. Those who had forecast North Korea's eventual collapse saw it as the pinnacle of a long story of communist dictatorship. Those who had predicted a military coup as ending the government remained on edge. Nothing of the sort happened and those predicting the fall of the Kim regime are still there, still predicting.

For the North Korean leadership, losing its heavy industrial base was actually an unintentional but fortuitous achievement. First, they were no longer forced to balance the needs of their uranium enrichment process within the underground facilities at the Sinanju Munitions Plant against the needs of their industries. Second, the shutdown of their heavy industries fed the general worldwide perception of North Korean incompetence and, it set the stage for the later windfall of food aid that would allow the leadership to remain in power, when any other regime would have faced internal revolt. Lastly, it allowed North Korea to close down most of its thermal electric power stations whose generated power was not as stable as that generated by hydroelectric power stations. The Sunch'on Heat and Thermal Power Plant was allowed to go derelict. Work ceased on thermoelectric plants under construction. Several that were nearly complete, never began operating. Progress on the East Pyongyang Heat and Thermoelectric Power Plant slowed to a crawl; it would not come online until sometimes in the 2000s. Several thermoelectric plants would however continue to operate but for different reasons.

The Pyongyang Heat and Thermal Power Plant, located in southeast Pyongyang continued operations to maintain appearances in the capital. Major blackouts in Pyongyang began in 1993. These would continue for three decades, often several times a week. Operations continued at the Rajin-Songbong Heat and Thermal Power Plant, only continued due to the bunker oil deliveries provided through the 1994 Geneva Agreed Framework. The Ch'ongch'on River Thermal Electric Plant, operated continuously spinning reserves as a backup to any failure of the hydroelectric

[351] Kim Jong Un's Green Agenda. My North Korea. 5 April 2020. http://mynorthkorea.blogspot.com/2020/04/kim-jong-uns-green-agenda.html

power supplying the uranium enrichment operations ongoing at the Sinanju Munitions Plant. The Ch'ongch'on River Thermal Electric Plant probably also supplied the Sinanju Munitions Plant variable frequency power as required. The North Koreans even admitting it. [352]

According to Chang Yung-shik, "the Chongchongang Thermal Power station has received lignite that was poorly sorted from the Anju District coal mining complex, and they are burning it. Even so, their turbines are not turning at full capacity…." [353] Chang was witnessing spinning reserves. Generators on standby, capable of generating emergency power at the blink of an eye.

By 1994, starvation reached into the country's largest cities. Hamhung, to name one such city, was devastated. [354] The next year, North Korean security forces, the dreaded secret police, uncovered a planned coup originating within the city but, that was in Hamhung, not Pyongyang. [355] The coup was suppressed, operations at the Sinanju Munitions Plant continued unabated.

Electric power production of at the Pukch'ang Heat and Thermal Power Plant continued, but declined in the early 1990s. This was reportedly due to low coal production. First it was the fault of the miners, but there were no leadership visits to spur the miners on to greater effort; later the floods of the mid-1990s were blamed. It was impolitic to lay the blame at the feet of miners who were not working to mine coal that wasn't needed to produce electrical power for industrial consumers who no longer existed. The plant continued to operate in a small capacity, but some of its generators were disconnected from their turbines. These generators were used to stabilize the fluctuating voltages found along a portion of a national grid, a portion now fully and continuously charged by North Korea's hydroelectric power stations. Recall that, power is used as it is produced.

As power was generated by the continuous operation of North Korea's hydroelectric power assets, the excess power generated needed somewhere to go. The excess was absorbed by the idle generators of the Pukch'ang Heat and Thermal Power Plant. Had specific North Korean factories been operational, some continuous processes within these plants might have been used to consume the excess. Operating idle generators burning excess power was however, much easier and less complicated. Besides, on again, off again production at North Korean industries that could not have been scheduled would have caused rumors, whispers that would reach outside ears. So, how had North Korea's inadequate electrical power system accomplished the task? It was simple really. They divided the grid.

Though North Korea's national electric power grid had, by fault of demand, developed more-or-less as an eastern and western system, due to later connecting lines that crossed the peninsula joining the two, the system could also be operated as a northern and southern grid. Somewhere around 1986, the grid was divided. There were now the "haves," and the "have nots."

The northern grid:
In the west, the national-level grid 220-kV substation installed when the Ch'ongch'on River Thermal Electric Plant was under construction in 1976 or 1977, was the dividing point on the national level grid preventing power produced on the Yalu River from reaching Pyongyang and points further south. The substation did however direct power to the EMIS facility. The Pukch'ang Heat and Thermal Power Plant control room was probably used to manage voltage fluctuations on this new "northern grid." It also probably managed the use of the plant's generators to stabilized those fluctuations. Pukch'ang's transformer substation marked the dividing line on the eastern side of North Korea with the new transmission arrangement, and prevented or managed the electrical power reaching

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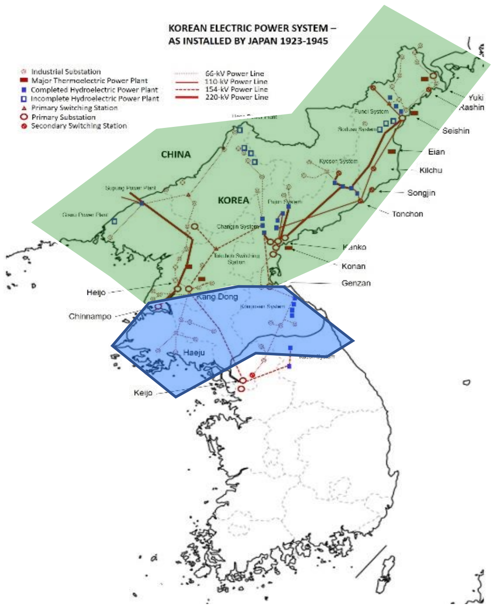
[352] Chapter IV. Energy Issues Endangering Economic Self-reliance. Institute of Developing Economics., Japan External Trade Organization (IDE-JETRO). IDE Spot Survey. Kim Jong-Il's North Korea-Arduous March. 1997.
[353] Chapter IV. Energy Issues Endangering Economic Self-reliance. Institute of Developing Economics., Japan External Trade Organization (IDE-JETRO). IDE Spot Survey. Kim Jong-Il's North Korea-Arduous March. 1997.
[354] Natsios, Andrew. The Politics of Famine in North Korea. NORTHEAST ASIA PEACE AND SECURITY NETWORK. SPECIAL REPORT. 8 Aug 1999
[355] Natsios, Andrew. The Politics of Famine in North Korea. NORTHEAST ASIA PEACE AND SECURITY NETWORK. SPECIAL REPORT. 8 Aug 1999

Pyongyang, and the 220-kV substation located south of the Ch'ongch'on River built in 1976 or 1977. However, even those North Koreans in the areas where the northern grid was concentrated would not have access to electricity.

To be totally clear, all of the power generated from the Japanese installed or designed hydroelectric power plants of the Chosin, Pujon, Kanggye and Sodusu Cascades and those along the Yalu River went into the facilities at the Sinanju Munitions Plant. That is why North Korea went dark – and stayed there. These plants were the most reliable hydroelectric plants in the entire North Korean electrical power system. It wasn't because they had been built by the Japanese. Much of the Japanese system had been destroyed during the Korean War. The turbine-generator sets had probably survived. The reason that the North Koreans relied upon these plants is mostly because they were reliable, and – they were there. Had Japan not designed, invested, and installed these plants, and had North Korea's communist allies not rebuilt these plants after the disastrous Korean War, it is unlikely that North Korea would have ever built a bomb. Overall, the communists in charge of North Korea are not known for investing in the country. Few industries not installed by the Japanese have ever appeared in North Korea after the rebuilding that followed the Korean War. These plants were that valuable.



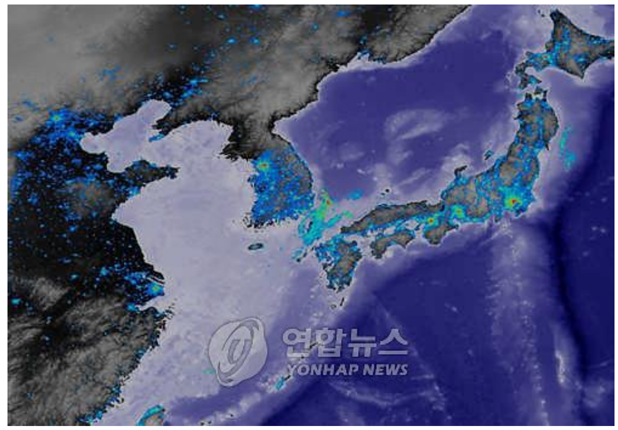
To ensure security, all North Koreans were required to suffer equally. To equalize or balance the needs of the population against the redirection of electrical power production into its uranium enrichment program, North Korea now emphasized the construction of new hydroelectric power stations. Construction on the Innam Dam to provide electrical power to the area of Wonsan began in 1986. Taech'on hydroelectric power plants Three, Four and Five were completed. Additional power stations were built along the Taedong and Ch'ongch'ong River. It was sacrifice but, it was sacrifice that was visible to the North Korean population and one they would support with their labor. It would however bring them little benefit.

Uranium enrichment by use of EMIS is a batch operation. It is likely, due to the length of North Korea's decades long energy shortage, a view held by those on the outside looking in, that there were or are several EMIS tracks operating within the underground facilities near Sinanju. The shortage of energy in North Korea was never ending. North Korea was suffering from an energy crisis even as Kim Il-sung was sworn into office in 1948, which had continued into the present day. With an electrical power system designed to support its industries as present in 1945, with excess energy production beginning to come online in 1942, little new industry installed during WWII, and the drain of South Korea's electrical power needs eliminated in 1948, why the continued energy crisis? North Korea had completed, or was continuing to complete, under construction and planned Japanese power stations. It rarely added any new industry that did not support its nuclear weapons project. It continued to build small- and medium-scale hydroelectric power stations, the majority of the country was dedicated to agricultural needs and yet, it has suffered from an energy crisis for the last 72 years. Wind power, solar power, tidal power plants were all exploited and yet, the country continued to suffer. Why?

The black hole:
During WWII the US Manhattan Project had ran two separate EMIS tracks, an Alpha and Beta track, to enrich uranium. The beta track was fed from the production of the alpha track. Iraq also planned to work its EMIS as an alpha and beta track operation. Its site at Al Tarmiya was supposed to house 90 alpha, and 20 beta separators. If completed, Iraq's planned Al Fajr EMIS Plant at Ash Sharqat would have revealed much larger ambitions. Like North Korea, Iraq's planned uranium program was also intended to rely solely on EMIS and centrifuges. It is

unknown how many separators North Korea operates in the underground facility the CIA identifies as the Sinanju Munitions Plant.[356] A batch process, EMIS operating times could be scheduled in advance.

If there were not several such systems operating within the underground facility, there would have been days, perhaps weeks, when electrical power could have been supplied to the rest of the country. It wasn't. There are only a few times, mostly around the birthday of North Korea's Great Leader, Kim Il-sung, when electrical power seemed relatively adequate. The more likely story was that these were periods of high-level regular maintenance to include replacement or rewiring of some magnets. EMIS is notoriously difficult to maintain and if maintenance is properly scheduled, the Great Leader's birthday could also be celebrated in style. Stranger things have happened. Then there are the winters in North Korea, when reservoirs empty and the already scarce electrical power becomes, even more scarce.



As for information, the facility was a black hole. From the Korean War on there was little information on Anju or Sinanju at all. Eight companies are presented in the larger press as important to Anju. These are the Namhung Youth Chemical Complex, the Anju Anillon Spinning Mill, the Anju Silicate Brick Factory, the September 28 Machine Factory, the Anju Telecommunication Machine Factory, Anju Silk Factory, Factory No. 121 (Anju Paper Factory) and the Ch'ongch'on River Thermal Electric Plant. The chemical plant is one of the largest factories on the western side of North Korea.[357] The chemical complex was commissioned in August 1976 along with the Ch'ongch'on River Thermal Electric Plant. A Technical University resides within the Namhung Youth Chemical Complex.[358] Anju Anillon Spinning Mill, constructed by the German Democratic Republic (East Germany) was opened in October 1987.[359] 94% of the total industrial production of the companies operating in Anju is financed by the North Korean government. The city also provides funding.

There was information on the Anju coal fields to the west, Kaech'on to the east, Sunch'on and Sukch'on to the south, and Yongbyon to the north, but little about Anju and Sinanju. During the Korean War, the two towns had been overrun by US, South Korean and UN forces. General Douglas MacArthur himself had flown into Sinanju on Friday, 24 November 1950 where he announced "if this operation is successful, I hope to have the boys' home for Christmas." So began the "home by Christmas campaign." Lin Piao, the leader of the Chinese People's Army Volunteers sat in the mountains only miles away to the north where, his force would launch itself against the ROK II Corps the following day. Douglas MacArthur had also been in other areas of Korea where facilities formerly associated with Japan's atomic energy and weapons program existed.

On 21 November Willoughby's staff reported that although early November saw the enemy on the offensive, a definite withdrawal in defensive trend had evolved over the past ten days. In contrast to the enemy's recent offensive efforts, which were aimed particularly at the Anju-Sinanju area, the enemy quite suddenly reverted, broke contact, and apparently withdrew to positions farther to the north.[360] Why was the enemy concentrated against the Anju-Sinanju area? Why would MacArthur go there signaling his intentions? Why allow his presence in certain cities and towns draw attention to other, darker places that no one wanted to admit existed?

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[356] New Munitions Plant Identified in North Korea. Imagery Analysis Report. National Photographic Interpretation enter. Formerly classified "SECRET." Sanitized Copy Approved for Release 2010/05/19: CIA-RDP80T00556A000100110001-3
[357] Dormels, Rainier. Profiles of the cities of the DPR Korea – Anju. North Korea's Cities. Jimoondang, Seoul. 2014
[358] Dormels, Rainier. Profiles of the cities of the DPR Korea – Anju. North Korea's Cities. Jimoondang, Seoul. 2014
[359] Dormels, Rainier. Profiles of the cities of the DPR Korea – Anju. North Korea's Cities. Jimoondang, Seoul. 2014
[360] Richard G. Stillwell. Lecture to U.S. Army Psychological Warfare School Guerrilla Warfare as Conducted in the Far East. 25 July 1956, p. 8. Papers of General Richard G. Stillwell, USA (retired) Box 20: Subject Folders ñ Speeches, Papers 1914-1976, Folder: Lecture Guerrilla Warfare as Conducted in the Far East- 1956, USAMHI. Cited in Peter G. Knight. "Macarthur's Eyes:" Reassessing Military Intelligence Operations in The Forgotten War, June 1950 - April 1951 Dissertation Presented in Partial Fulfillment of The Requirements for The Degree Doctor of Philosophy in The Graduate School of The Ohio State University., M.A. The Ohio State University 2006

It was not the CCF front line picture that was ever truly a mystery to the Eighth Army. What remained in question was the strength of the units echeloned and held in reserve behind the enemy's front line. Given the CCF's tendency to move at night and hide in daytime, the only way to find them was to observe their formations on the ground. The insertion of partisan agents behind enemy lines discussed earlier in conjunction with Operations Aviary and Racketeer demonstrated a clear effort on the part of Willoughby's theater intelligence system to acquire the necessary intelligence on CCF forces. Yet, former Chief of CIA Partisan Operations, Colonel (later General) Richard G. Stillwell, US Army lamented that many of his agent teams were held back from action in late October and early November 1950 when the intelligence they could gather was most needed. He could not fathom the decision to cancel planned missions, especially for the teams that were assigned to cover Sinanju and the Changjin [Chosin] Reservoir areas. [361] Why were intelligence gathering missions planned for the areas of Sinanju and the Chosin Reservoir? What was in Sinanju that drew such attention? What was up in the mountains surrounding the Chosin Reservoir that required such effort? Just days after MacArthur's planned winter campaign was launched, American, ROK and UN forces would still be advancing, only in a different direction. North Korean winters were another thing altogether.

Winters in North Korea are generally long, harsh and dry. Long before North Korea began its uranium enrichment program, winters in the country were so dry that almost all industrial activity, under the communists, of any kind ceased. Little industry ran at all. Most industrial activity was conducted during the early summer through late fall. It is likely that North Korea's EMIS facility shut down for at least some portion of the winter. But what made the site so obviously an EMIS facility? It was the site's signatures, or characteristics.

Singular and composite signatures:
To understand North Korea's EMIS site was to understand the WWII-era Manhattan Project. Whether due to physics, management styles, or security regimes, the Manhattan Project became the standard for all of the world's ensuing programs. A signature consists of some distinctive pattern, product, or characteristic – usually observable – by which someone or something can be identified. A composite signature is a group of signatures that are related in such a way to more completely or further define a target or operational endeavor at a higher fidelity. Everything that exists at the Sinanju Munitions Plant in North Korea, in Pakistan, Iraq, Iran and elsewhere, had previously existed within the US Manhattan Project of WWII. There was nothing at the site that shouldn't be there, nothing that could point to some competing hypothesis. It wasn't an iron mill, a glass plant or even a munitions plant. There were no large piles of sand, of coal, of aggregate that might suggest some other function. It met no other criteria than that of a uranium enrichment plant supporting an EMIS, a centrifuge hall and UF^6 storage site. The first signature to be identified were the most basic.

The single most important signature in the confirmation of an operating clandestine uranium enrichment facility is found in "*A General Account of the Development of Methods of Using Atomic Energy for Military Purposes*," released to the public on 12 August 1945 and consists of three parts.[362] First and foremost, the scale of expenditure provides a rough index of activity. Second, the level of observable activity within and around the facility, regardless of the number of people assigned, will always be low. There would be no large trucks passing through the facility,

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[361] Richard G. Stillwell. Lecture to U.S. Army Psychological Warfare School Guerrilla Warfare as Conducted in the Far East. 25 July 1956, p. 8. Papers of General Richard G. Stillwell, USA (retired) Box 20: Subject Folders ñ Speeches, Papers 1914-1976, Folder: Lecture Guerrilla Warfare as Conducted in the Far East- 1956, USAMHI. Cited in Peter G. Knight. "Macarthur's Eyes:" Reassessing Military Intelligence Operations in The Forgotten War, June 1950 - April 1951 Dissertation Presented in Partial Fulfillment of The Requirements for The Degree Doctor of Philosophy in The Graduate School of The Ohio State University., M.A. The Ohio State University 2006
[362] Smyth, Henry D. Atomic Energy for Military Purposes. The Official Report on the Development of the atomic Bomb under the Auspices of the United States Government, 1940-1945. Princeton University Press. Princeton, New Jersey. 1945

no regular vehicle traffic, and little discernable human movement. Lastly, and it cannot be stressed enough, there will little, if any, observable output. Though imagery of the facility available through Google Earth and other sources is limited, the facility met the basic criteria established. The next set of criteria came directly from the Manhattan Project and represented its founding objectives.

According to the research conducted against the WWII-era US Manhattan Project a suspected or clandestine uranium enrichment facility should: Have access to a large amount of continuous electric power, enough for a fair-sized city. Be located in a relatively remote area with limited housing. Have access to a large quantity of water for cooling and processing, as well as construction and operating requirements. Be located near a main line railroad and good access roads to ensure delivery of heavy construction materials and supplies. Be geographically isolated. Take advantage of local topography such as natural barriers, rivers and hills. Possess sufficient level terrain; a ready supply of sand and gravel, for speed and economy in building the various facilities. Ground and subsurface conditions favorable for heavy construction. Contain adequate and suitable space for a town which will eventually possess sufficient housing and other facilities to support hundreds of workmen, technicians, and their families. The Sinanju Munitions Plant met all these criteria. Electrical power however was key in its identification.

The facility was supported by four to seven layers of electrical power redundancy, eight if emergency generators were counted. First, the plant was supported by a national-level 220-kV transformer substation built west of Anju in 1976 or 1977. The substation stepped 220-kV power received from the massive and stable Supung hydroelectric and other power stations located along the Yalu River down to 66-kV. Two double-circuit 66-kV lines, four circuits total, extended south from the 220-kV transformer substation, providing a distribution grid that the Sinanju Munitions Plant could tap to support its operations. Each line supported a tap extending power from that line into the underground facility which supports the EMIS. Another, 66-kV transformer established adjacent to and after the original 220-kV substation had been built, extended a direct line to the EMIS housed in an underground facility within the Sinanju Munitions Plant.

A separate 66-kV substation, collocated with the 220-kV substation, extended a 66-kV single-circuit line from the substation again, directly into the underground facility which supports the EMIS. There are a series of underground diesel electric generators also located on the installation, however these probably provided direct support to the centrifuge hall and not the entire installation. A 66-kV substation was also located within the installation probably stepping power down to 22- or 11-kV which supported all functions, to include the EMIS system and centrifuge hall supported by the installation, the installation's machine shop and weapons assembly plant. The installation's machine shop and weapons assembly plant are supported by a 22-kV transformer substation, that receives it power directly from the 66-kV transformer substation mentioned above. The Ch'ongch'on River Thermal Electric Plant served as the process's emergency backup but also provided a source of variable frequency electrical power. Looking at the site's electrical power, North Korea's clandestine uranium enrichment program, wasn't clandestine at all. Unlike Iraq's various uranium enrichment facilities, with their underground powerlines, the North Koreans made little effort to hide its clandestine program. As for isolation, the location today is not as isolated as it was when it was selected in 1943 however, it remains relatively isolated.

In 1950, as the image below shows, Sinanju was not a wasteland but, it was relatively isolated. The Nichitsu barracks were about the largest buildings in the area. It was larger than a hamlet or a village but it was not quite yet a town of any size. Housing obviously, as required by the Manhattan Project was limited, but the area was conducive to the future expansion of housing and other support facilities. The Ch'ongch'on River would supply the sand and aggregate for future construction.

According to a bomb assessment conducted by the US Air Force, over the course of the Korean War, 100 percent of Sinanju was destroyed by the US bombing, quite the target for nothing there. The area remains relatively remote. In 2006, the area's population was estimated at just 16,000 people, a controllable number. Most of the destruction brought to the area during the Korean War, resulted from attacks against the railroad passing Sinanju and its railyards, meeting yet another of the Manhattan Project's requirements; ready access to major railroad. Water for the site was of course, provided by the Yongpung Reservoir through Anju Water Utilization Works. Though the early years of the project were probably exhausting, conditions were probably about as good as those supporting the Manhattan Project's, Site-Y, at Los Alamos, New Mexico. The remaining signatures that might indicate a uranium enrichment facility would come, as they did with all Manhattan Project facilities, over time. Continuous investment over time is one more of the few methodologies available to confirm the existence of a uranium enrichment process.

Roads inside and leading to the facility would begin as dirt roads and would remain so for a number of years if not decades. These were eventually oil-covered, then graveled and finally paved with concrete. For years North Korea's leadership reached the location over improved secondary roads that would later be turned into a major expressway. Major turnoffs nearer to Sinanju completed the scene however, each led onto a road that extended west into Sinanju, east directly into the facility. Again, it's hard to argue that North Korea had gone far to hide the facility as a clandestine operation. As the Manhattan Project had indicated, the facility would be located near a major railway and, as the US project had done, the rail was extended to the facility however, it never extended into any area that could have been considered a munitions production, loading and transport facility.

The railroad was dead-ended into the facility apparently to carry in heavy construction materials, including completed magnets or racetracks. The railroad spur was not located in any area where conventional munitions might be produced and distributed outside the facility, calling into question its original assessment as a munitions plant. Heavy steel beams and sheet steel were probably needed to shore up and support underground areas. Tons of concrete were probably carried in once the facility's undergrounds had been excavated, and were then concrete-lined. Several railyards located with 15-20 miles of the facility were probably used to hold railcars loaded with materials, and are likely to have been observed while standing by, and probably made their way to the munitions plant loading docks at night so as not to draw attention. The railheads at the Ch'ongch'on River Thermal Electric Plant and Namhung Youth Chemical Complex were also probably used to hide materials awaiting delivery to the enrichment plant. If no one suspected what was actually going on in the Sinanju Munitions Plant, why would anyone monitor the area's railyards? The simple answer was that, they wouldn't. The plant's underground facilities were extensive.

The plant houses at least four major underground facilities, maybe up to six or seven major functions within those hollowed-out mountains. Smaller underground facilities also exist. Judging from the lack of heavy power and the short rail lines entering a group of four underground entrances, one of the underground facilities probably serves as a UF^6 storage area. A gantry crane located nearby is probably used to offload UF^6 containers onto gondolas that are then manhandled to the rail tracks and then pushed into the underground facility. A second set of three entrances receiving electrical power from the installation's main 66-kV transformer substation at 22- or 11-kV, possibly lower, is likely to house North Korea's first operational centrifuge cascade. It would be one of several such halls built and placed into operation in various underground facilities across North Korea in the late-1980s and early-1990s. This facility is also likely to hold some form of uranium purity test facility.

The southernmost underground facility over a hill and across the valley, receives 66-kV power directly from the 66-kV distribution system extending from the 220-kV substation, built in the mid-1970s mentioned before, and the Ch'ongch'on River Thermal Electric Plant located north of Namhung Youth Chemical Complex. This underground facility holds North Korea's EMIS system. A smaller underground facility located under the hill directly north of the EMIS, between the EMIS and the centrifuge hall, is likely to hold the installation's water management system. This system stems from the water tunnels built in the 1950s through the valley as planned by the Japanese during WWII, and later completed under the Anju Water Utilization Construction Works project of North Korea. This facility manages all water entering and exiting the installation. The underground facility also manages the water stored aboveground in various ponds and other containment areas spread across the surface area of the installation. It is highly probable that the hill also hides an underground water storage area. There are other underground facilities in the installation.

To the immediate east of the EMIS there is possibly another underground that houses a waste storage facility. There are signatures which support the assessment but little supporting information. Father east lies the installation's aboveground weapons assembly plant, a series of long single-story buildings laid out alongside a tributary of the

Ch'ongch'on River. Areas within this part of the installation are heavily secured. Electrical power here is managed by a 22-kV single-transformer substation fed by the installation's primary 66-kV substation located on the primary base housing the EMIS Facility. Immediately due south of this branch of the plant, lies another series of underground facilities accessed by a single concrete entrance later covered with dirt to hide its existence. These are probably used to store completed weapons, uranium and uranium cores and composite weapons cores. Access to this underground facility is probably limited to only those few trusted, and politically reliable officials that manage the program or are concerned with its security. Immediately adjacent to the underground area lies three dirt-bunkered, black-powder storage buildings identified by their numerous lightning rods.

But wait, there's more:
[From the Tokyo Sankei Shimbun, 9 June 2000] SANKEI SHIMBUN: DPRK SECRET UNDERGROUND FACILITY PRODUCING URANIUM (By Katsuhior Kuroda) SEOUL, 8 June – North Korea has reportedly utilized natural uranium produced in the country as raw material for its nuclear weapons development program. Meanwhile, Sankei Shimbun has obtained a detailed report on North Korea's secret underground plant for refining natural uranium and its material production procedures. The secret underground plant is widely called "Mt. Chonma Power Plant," located at Mt. Chonma in North Phyongan Province. North Korea has operated the plant in secret since the end of 1989 for uranium production for the nuclear weapons program, the report said. [363]

EX-MILITARY OFFICIAL WHO FLED TO CHINA UNVEILS EXISTENCE OF PLANT. The report was drawn up based on statements made by North Korean military official Yi Chun-song [name as transliterated], 66, during interrogation by Chinese authorities. Yi is former vice director of the operation bureau of North Korean Ministry of People's Armed Forces who served as commander in chief at a missile station. He fled from North Korea to China last year and was held in Chinese authorities' custody. The report said that the "Mt. Chonma facility" has a uranium refining capacity of 1.3 grams a day. By simple calculation, the production during the past 10 years of operation would amount to approximately 5 kg. Concerning North Korea's uranium production plants, there are some unconfirmed information including plants in Pakchon [Pahch'on] and Pyonsan [Pyongsan], but this is the first time that an accurate location and details of the inside of the facility were unveiled. According to the report, the ''Mt. Chonma facility" is built in a large tunnel under the 1,116-meter mountain. Soldiers of the 2nd Division of the Engineering Bureau of the Ministry of People's Armed Forces started constructing the facility in 1984 and completed the work in 1986 [again, 1986]. The uranium-producing operations started in 1989. [364]

Approximately 400 people, including 35 engineers and 100 managers, are working at the plant. The rest are physical laborers who were all political prisoners sentenced to life in prison. The uranium minerals are brought into the facility from mines in Songchon, South Phyongan Province, and Sohung, North Hwanghae Province, by the transportation unit of the Ministry of People's Armed Forces. [365]

The report said that the arched entrance of the tunnel is 7 meters wide and 6 meters high. A pathway of about 2.5 km is connected to the entrance, and there is a corner at the end of the pathway. Making a 90-degree right turn and going along the path about 1 km, you will find a 6-km-long main tunnel with a width of 15 meters and height of 6 meters. The inside surface of the tunnels is covered by aluminum plates, and there are 3-meterwide drains and ventilation openings there. [366]

The underground plant is comprised of 10 areas—two concentration grounds measuring 3,000 square meters each, a drying room of 400 square meters, four 400 square-meter wide dissolution rooms for uranium extraction and refining, a room for packing uranium into containers, storage for the finished products, and a room where the workers change into anti-radiation suit or take breaks. [367]

The report said there is a waste disposal facility in the plant in addition to the areas mentioned above. The packed uranium products are carried out of the facility through a passage at the end of the tunnel and transported to an underground storage area in Anju by helicopter. The report added that although forests in the Kumchang-ri area, 30 km southeast of Chonma, were polluted by water discharged from the Chonma facility, the United States could not

[363] Kuroda, Katsuhior. DPRK SECRET UNDERGROUND FACILITY PRODUCING URANIUM. SANKEI SHIMBUN. SEOUL, 8 June 2000
[364] Kuroda, Katsuhior. DPRK SECRET UNDERGROUND FACILITY PRODUCING URANIUM. SANKEI SHIMBUN. SEOUL, 8 June 2000
[365] Kuroda, Katsuhior. DPRK SECRET UNDERGROUND FACILITY PRODUCING URANIUM. SANKEI SHIMBUN. SEOUL, 8 June 2000
[366] Kuroda, Katsuhior. DPRK SECRET UNDERGROUND FACILITY PRODUCING URANIUM. SANKEI SHIMBUN. SEOUL, 8 June 2000
[367] Kuroda, Katsuhior. DPRK SECRET UNDERGROUND FACILITY PRODUCING URANIUM. SANKEI SHIMBUN. SEOUL, 8 June 2000

detect the Chonma plant despite the technical team's inspections in Kumchang-ri. [368] The material generated by the Chonma plant was transported to – Anju. Most likely to the Sinanju Munitions Plant as identified by the CIA in 1979. The location of the actual Chonma plant is a subject for another paper.

According to Yi's career record attached to the report, Yi graduated from Pyongyang University of Technology, and studied at Frunze (now Bishkek) military university of the former USSR from 1958 to 1962. A South Korean source said that Yi attempted to defect to a third country after fleeing to China, but it is highly likely that he was sent back to North Korea by Chinese authorities. [369]

The problem with the report above is that it is a translation, of a translation of a translation. Yi Chun-song was a Korean being debriefed by Chinese who, were probably somewhat fluent in Korean [Hangul]. The Chinese report had been "obtained" by the Japanese who first, translated it into Japanese. This translation was used to further translate the report into English. The report has cultural and language errors interspersed with numbers and fact. Numbers can be especially difficult to translate even if they are in the Hindu-Arabic numeral system which, might not have been used in the original debrief, probably weren't in the Japanese translation, but were used in the English version. The 1.3 grams a day is just as likely to be 13 grams a day.

Place names are generally correct from version-to-version as are distances, of which Chinese, Koreans and Japanese are aware of the historical origins and current use translations to miles or kilometers. Directions, east-west, north-south, right-left and left-right generally cause confusion and depending on the number of translations, the cultural orientation of the original speaker can wind up 180-degree off – one direction or the other. If it does not match the map going north as told, go south. If it is not on the left, look to the right. Simple as that. While that is important for locating the Mt. Chonma facility, comments regarding Anju bore no inaccuracies, materials produced were "transported to an underground storage area in Anju by helicopter." [370]

Conclusion:
The Sinanju Munitions Plant as identified by the CIA is definitely a munitions plant, but not a conventional weapons munitions plant. The Sinanju Munitions Plant represents the center of gravity for North Korea's uranium enrichment effort. It is their Oak Ridge, Tennessee combination Los Alamos, New Mexico. Nuclear weapons-design is however accomplished elsewhere. Though there are other underground centrifuge halls and many weapons storage bunkers, this is North Korea's only EMIS facility.

EMIS was declassified immediately after WWII because no one thought any nation would use it, instead every nuclear weapons program since WWII has used it in some form. Iraq is the most notorious offender in recent memory however, it probably obtained more information from North Korea than Saddam Hussein gave. Iraq's Al Tarmiya EMIS system (built in late-1987) was a gleam in Saddam's eye when North Korea's Sinanju Munitions Plant was originally identified.

The acquisition of a nuclear weapons capability has been a North Korean national goal since the late-1940s, but of its Great Leader since 15 August 1945. Its nuclear weapons program is 75 years old. North Korea's weapons program has always been less concerned with regime survival than cultural survival, which its leadership has assumed as its mantle. That the country has an EMIS system should come as a surprise to no one. No amount of sabre rattling or fist shaking can undo what the program has achieved in its 44 years of testing and operations. No direct attack can undo what is has already accomplished and that is to provide feedstock to North Korea's various centrifuge cascades. If no one knew the location of North Korea's primary uranium enrichment facility, they should have when A.Q. Khan admitted to being in such places when he visited the country in 1996. The damage is already done.

Many others have advanced the idea that uranium enrichment facilities exist in various places in North Korea. David Albright writing in *North Korea's Suspect, Former Small-Scale Enrichment Plant* posited that the Panghyon Aircraft Plant, near Panghyon Air Base in the region of Mount Chonma could hold a centrifuge enrichment plant. [371]

[368] Kuroda, Katsuhior. DPRK SECRET UNDERGROUND FACILITY PRODUCING URANIUM. SANKEI SHIMBUN. SEOUL, 8 June 2000
[369] Kuroda, Katsuhior. DPRK SECRET UNDERGROUND FACILITY PRODUCING URANIUM. SANKEI SHIMBUN. SEOUL, 8 June 2000
[370] Kuroda, Katsuhior. DPRK SECRET UNDERGROUND FACILITY PRODUCING URANIUM. SANKEI SHIMBUN. SEOUL, 8 June 2000
[371] Albright, David. North Korea's Suspect, Former Small-Scale Enrichment Plant. INSTITUTE FOR SCIENCE AND INTERNATIONAL SECURITY. IMAGERY BRIEF. 21 July 2016

The facility does not however, meet the requirements for separate and redundant layers of electrical power. Neither does the much ballyhooed Kangson uranium enrichment site for that matter.

North Korea's hydroelectric power system was largely installed for the sole purpose of supporting the needs of Nichitsu but was later expanded to produce a uranium-based bomb. Neither Japan, nor later North Korea, were ever seriously interested in the installation of coal-fired thermoelectric power stations. Japan never constructed one large-scale thermoelectric power station on the peninsula during the 40 years of their colonial rule. During the Cold War, North Korea only accepted them as a form of foreign aid. The installed electrical power system grew, due to geography largely to become a nearly separate eastern and western grid. Transmission lines connecting the two grids, and thermal electric generators installed in near the middle of the country allowed the grid to be operated as a nearly separate northern and southern grid. This grid arrangement allowed North Korea to concentrate its most stable hydroelectrical power system into its EMIS. The decision to force this arrangement was costly for the economy, costly in terms of building a nuclear weapon and extremely costly in lives.

As with most other nations, North Korean began its search for a nuclear weapon with a uranium enrichment program. It did not seek a plutonium weapons capability first. Its plutonium program was simply watched closer and became the area of primary concern, to the detriment of all other means to obtain a weapon. Are plutonium weapons capable of great destruction? Yes. Does it matter? No. The first nuclear attack anywhere will set off shockwaves of irrational fear around the world. Its existence was obvious, any failure to identify the facility was self-inflicted. When it was identified in 1979 the Sinanju Munitions Plant had few of the signatures normally related with a munitions plant and all of those associated with a uranium enrichment plant.

North Korea's advances in the field or uranium enrichment were never their own, but always the result of a transfer of technology illegally purchased or stolen, most of it stolen. Every possible loophole in the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) was exploited in fact, some countries turned a blind eye to North Korea efforts to obtain duel use technology and will bear a portion of the blame should Pyongyang use a nuclear weapon in combat.

According to clues gleaned from political statements and reorganizations at the national and local governments to include Anju County being raised to the status of a city in 1987, suggests that the facility probably began testing in 1986 and full operations in 1989. As uranium weapons are easier to build and require no testing, it is likely that North Korea built its first working uranium-based weapon in 1992 or 1994. The actual number of weapons in North Korea's arsenal are likely an order of magnitude higher than currently assumed.

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