History of the Russian Nuclear Weapon Program

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Potsdam Conference was held at Potsdam, Occupied Germany. The Trinity test occurred on July 16, 1945 or the day before the conference began. Passed notes that “the baby was born,” Truman and Churchill knew of the successful test. When informed by Truman, Stalin seemed unimpressed. Soviet espionage that had penetrated the joint US/UK atomic weapons program had already informed him.
История русской ядерной программы

THE SOVIET PATH FORWARD VIA ESPIONAGE
USSR’S ATOMIC SPIES “TRACK FOUR”
“ENORMOZ” (Russians term for the Manhattan Project)
(Background documents, declassified and used in Federal trial of Rosenbergs)
Morris and Lona Cohen, handlers of Perseus, fled to the UK under the names Helen and Peter Kroger. After their arrest and prosecution in the UK, they were exchanged for Gerald Brooke and flown to Russia where they were welcomed as heroes.

- Joined the Manhattan Project in 1942
- Physicist passed information to the Cohens
- Associated with the Spanish Civil War
- Still alive and in the USA as of October 1992

“Kroger” Home in Ruislip, UK

aka Helen and Peter Kroger

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George Koval died in Moscow on 31 January 2006. His role was never officially recognized until 2 November 2007, when the Kremlin announced his posthumous decoration with the highest state honor, “Hero of Russia.” Cited among his major contributions to the Soviet atomic project was the design of the “neutron fuse” for the first Soviet atomic device, which was tested on August 23, 1949. Koval was cited for “his courage and heroism while carrying out special missions and was the only Soviet intelligence officer to infiltrate the Manhattan Project’s secret plants.”
История русской ядерной программы

EARLY DEVELOPMENTAL PATH DOWN TO JOE-1
For the Soviet nuclear weapons program, the most significant contribution from the defeated Third Reich was the location and seizure of 300 tons of uranium, 100 tons from the heavily bombed Auergesellshaft plant in Oranienburg and 100 tons from a leather tanning factory in Neustadt am Glewe. This material was used to fuel Reactor “A” located in the Urals that provided plutonium for JOE-1. In addition, German scientists such as Nicholaus Riehl and Gernot Zippe provided the Russians with information on uranium metallurgy and enrichment. Likewise, captured German rocket technicians and rockets (such as the Wasser Fall) helped “jump start” the Russian IRBM and ICBM programs.
Former Third Reich Scientists Who Assisted in the Russian Nuclear Weapons Program

Nicholas Riehl
Karl Zimmer
Robert Doepel
Manfred von Ardenne
Peter Thiessen
Max Volmer
Gernot Zippe
Heinz Barwich
Gustav Hertz
On 9 April 1946, a secret statement of the USSR Soviet of Ministers was adopted, establishing the Design Department N11 (KB-11) under the auspices of the Second Laboratory of the Academy of Sciences. General Pavel Zernov, the production manager, headed KB-11, whereas Yuri Khariton was assigned responsibility for the scientific issues.
Arzamas-16
Арзамас-16
AKA Sarov or VNIIEF
Sakharov’s Home
St. Seraphim Church
I. Kurchatov  A. Sakharov  Y. Khariton  G. Flerov
The pressure to test with a 100% chance of success....

Fuch's “Fat Man” Diagram
From 1949 to 1993, at least 456 nuclear weapon tests were conducted in a remote part of eastern Kazakhstan, in the province of Semipalatinsk. Kurchatov City was the entry point for the three major test areas --- (1) Experimental Field where the first Russian test (Joe-1) occurred, (2) Balapan where atmospheric tests occurred, and (3) Degelen Mountain where underground tests were carried out. Locals called “Kurchatov City” “Наш Город” or “Our Town.”
Kurchatov City (2013)

Beria’s dacha, now a church
Lavrenty Pavlovich Beria

Beria was appointed the administrative leader of the Soviet nuclear weapon program. Kurchatov remained in charge of the scientific research. Shortly after the atomic bombings of Japan in 1945, Stalin issued an ultimatum to Beria ordering the “bomb” to be built and tested within five years. NKVD Special Department “S” was established by Beria to organize intelligence documents gathered about the U.S. bomb and to accelerate the research efforts. The bomb was ready for testing within four years. The Russian scientists would have preferred testing their own design but opted for a copy of the US Trinity device because Beria had informed them that they would be executed if the test failed.
SHIPMENT OF JOE-1 DEVICE TO SEMIPALATINSK BY RAIL
JOE 1 Test

Data Collection Tower “Goose”
JOE 1 Experimental Layout Plan

One of 14 Data Collection Towers aka “Geese”
JOE-1 Test Layout Model

Effects seem more important than the device
РДС-1 (RDS-1 or Reaktivnyi Dvigatel Stalina) was a copy of the Trinity (Fat Man) device and demonstrated that Russia could manufacture and test nuclear weapons. As promised, executioners in black leather were in the bunker at the time of the test. The letter is from Beria and the scientists thanking Stalin for his leadership in the success. In the blue note at the top left, Stalin responded, "Where is Nicholas Riehl’s signature?"
JOE-1 Control & Observation Bunker
JOE-1 Crater

Kharitonchiki
Of interest -- one day before President Truman’s announcement of the 1 September 1949 test-- an intelligence estimate produced by the CIA's Office of Research and Estimates (ORE) assessed that mid-1953 would be "the most probable date for a Soviet nuclear test." This assessment paper was coming off the presses when filter papers loaded with radiological debris from JOE-1 were being taken off AFLOAT-1 aircraft.
Considering the distances involved, Oppenheimer had believed it highly unlikely that debris from a Soviet nuclear test could be detected.
История русской ядерной программы

NUCLEAR WEAPON TESTING AFTER JOE-1
Semipalatinsk Nuclear Test Site

Lake Chagan
Degelen Gora Nuclear Test Site

http://www.youtube.com/watch?v=kPLQ4yEXFPc
Novaya Zemlya Nuclear Test Site
Novaya Zemlya Nuclear Test Site
Support Base
Novaya Zemlya Nuclear Test Site
Novaya Zemlya Nuclear Test Site (cont’d)

~40 Instrumentation Vans
It is likely that the Joe-2 design was provided to the Chinese. From 1958 until 1959, Arzamas-16 weaponeers led by Colonel E. A. Negin, N. G. Maslov and V. Gavrilov were assigned to China and provided the Chinese with extensive information on 1950-vintage fission weapons. Qian Sanqiang was the primary interface.

After Klaus Fuchs was released from prison on 23 Jun 1959 and moved to East Germany, he met with Qian and authenticated the design information Russia had given to China.
JOE-3 First Soviet Airdropped Test

41.2 KT

18 October 1951
**JOE-4 “Layer Cake”**

12 August 1953

400 KT

*RDS-6c employed a design called the Слойка, a type of layer cake.*
The RDS-4 (JOE-5) design would also be introduced into the Russian arsenal as the warhead for the R-5M medium-range ballistic missile.

RDS-4 (JOE-5) was a fission device using plutonium in a "levitated" core design. The test was an air drop on August 23, 1953, yielding 28 KT.
First Soviet nuclear explosion in a military training exercise involved ~45,000 troops. Totskoye Range, the location for Snezhok was chosen because its topography was similarity to West Germany. Regrettably for the Russians, wind carried the airdropped device and its detonation debris toward the participants. Thousands of Russian soldiers were contaminated.
The first test of the РДС-9 design on 19/10/1954 was a fissile.
Utilized “staged, radiation implosion” called “Sakharov’s Third Idea”
Chagan PNE "Atomic Lake"

“Industrial Nuclear Explosion”
140 KT - 15 January 1965
Aggregate Declared and Detected Tests 1945-2013

Worldwide nuclear testing, 1945 - 2013

- United States
- Soviet Union
- United Kingdom
- France
- People's Republic of China
- Pakistan
- India
- North Korea
Russian Nuclear Weapon Complex

Nuclear Weapons Production Complex

- Moscow
- Arzamas
- Zlatoust
- Sverdlovsk
- Chelyabinsk
- Penza
- Novaya Zemlya
- Tomsk
- Krasnoyarsk
- Angarsk
- Semipalatinsk
Russian Nuclear Weapon Complex

Sarov, Arzamas-16, Sarova, Avangard Nuclear Weapon Physics/Design, Nuclear Weapon Assembly/Disassembly
Snezhinsk, Chelyabinsk-70, Kasli Nuclear Weapon Physics/Design
Ozersk, Mayak, Chelyabinsk-65 (40) Plutonium Production, Tritium Production, Weapon Component Fabrication
Zelenogorsk, Krasnoyarsk-26, Dodonovo Plutonium Production
Tomsk-7, Seversk Plutonium Production, Uranium Enrichment
Zelenogorsk, Krasnoyarsk-45, Uranium Enrichment
Angarsk, Uranium Enrichment
Novoural'sk, Sverdlovsk-44 Uranium Enrichment
Zarechny, Penza-19 Nuclear Weapon Assembly/Disassembly
Lesnoy, Sverdlovsk-45, Nuclear Weapon Assembly/Disassembly, Weapon Component Fabrication
Tryokhgorny, Zlatoust-36 Nuclear Weapon Assembly/Disassembly
Novaya Zemlya Nuclear Test Site (former Semipalatinsk, Degelen Gora)
RESEARCH AND DEVELOPMENT INSTITUTES
Founded 1946 at Sarov (Arzamas-16)

- Stewardship of the Russian nuclear stockpile and improved efficiency, safety and reliability of nuclear warheads
- Development of combined computer simulation methods for various physics phenomena using advanced high-performance computing systems
- Advanced design methods for complex engineering systems
- Hydrodynamics of transients, detonation physics and technology;
- Nuclear physics and radiation physics
- Development and operation of research reactors for the purposes of science
- Development and operation of technologies for control and accountability of nuclear materials
- Science and technology support of the international arms limitation and nuclear nonproliferation treaties
Rocket Sled Facility
Arzamas-16 / 2012
Arzamas-16 Museum

First Russian Tactical Missile Warhead, 10 Kt

RDS-6c “Layer Cake”
First mass-produced tactical nuclear bomb - "RDS-4"

R-7 ICBM Warhead
NATO SS-6 Sapwood

IRBM
40 KT Warhead

2 MT Warhead

152mm Nuclear Shell
Founded 1955 at Snezhinsk
Stewardship of the Russian nuclear stockpile and improved efficiency, safety and reliability of nuclear warheads
Properties of substances in a wide range of pressures and temperatures
Kinetics of explosives
Thermonuclear reactions
Plasma physics
Turbulent mixing
Gas dynamics
Inertial thermonuclear fusion
Physics of the interaction of laser radiation with matter
Astrophysics
Computational mathematical modeling.
KASLI --- VNIIE TF

Light SLBM Warhead

Sub-Launched Missle Warhead

Warhead for New Missile

Compact Thermonuclear Charge
Nikolai L Dukhov Institute of Automatics VNIIA

All-Russian Research Institute of Automatics

NOVOSKOBDYKAYA SITE

TZARITZYNOST SITE

MOSKVORECHIE SITE

Nikolai L. Dukhov
История русской ядерной программы

FISSILE MATERIAL PRODUCTION FACILITIES
Mayak Plutonium Recovery & Conversion Facility
Zheleznogorsk Plutonium Production
KRASNOYARSK-26
Zheleznogorsk Plutonium Production

KRASNOYARSK-26  “DODONOVA”
Seversk Plutonium Production
TOMSK-7
Angarsk Electrolysis Chemical Complex (Uranium Enrichment)
Novoural'sk Uranium Enrichment
SVERDLOVSK-44
Zelenogorsk Uranium Enrichment
KRASNOYARSK-45
Seversk Siberian Chemical Combine
TOMSK-7 URANIUM ENRICHMENT
Ancilliary Tritium Production from RBMKs

"High Power Channel-type Reactors"
WEAPON PARTS
PRODUCTION
FACILITIES
Mayak Pit Facility
SECTION OF CHELYABINSK
Arzamas
Avangard
Warhead
Assembly/
Disassembly
Facility
Kasli (Касли) Area 9
CHELYABINSK-70 VNIITF
Lesnoy Weapon Parts/Assembly
SVERDLOVSK-45 Лесной
Zarechny Weapon Parts/Assembly
(PENZA-19)
RUSSIAN NUCLEAR WEAPONS
Zarechny Nuclear Weapons Museum
NUCLEAR WEAPON DELIVERY SYSTEMS

R-9 - SS-8
SASIN
Russian Strategic Bombers

Boeing B-29 Super Fortress

Tupolev Tu-4 (NATO codenamed ‘Bull’)

TU-60 Strategic Bomber

TU-95MS Bear

TU-22M3 Strategic Bomber

TU-60 Strategic Bomber
The Wasser Fall was designed as an anti-aircraft weapon and was used several times to destroy Allied bombers amassed in formations. With the fall of the Third Reich, Wasser Fall missiles, parts, production equipment, and the technicians who operated the German production line were relocated to the Soviet Union.

<table>
<thead>
<tr>
<th>Wasser Fall</th>
<th>Scud</th>
<th>No Dong</th>
<th>Ghauri</th>
<th>Shahab</th>
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Evolution of Russian Missiles to the R-7

R-7 was in service from 1960 to 1968 from four pads at Plesetsk and one at Baikonur (warhead RDS - 46.5 MT)
Russian Land Based ICBMs

SS-19
(RS-18, Stiletto)
Russia is developing a new heavy ICBM R-36M SS-18 SATAN

- (8F675 Mod2) 20 MT warhead for R-36M2 / SS-18 Satan ICBM (single)

- (8F021 2) 5 MT warheads for R-36MP / SS-18 Satan ICBM (3 MIRV warheads)

- (R-36 MUTTh Mod 4) 550 KT warheads for R-36M2 / SS-18 Satan ICBM (10 MIRV warheads)

- (R-36M2 Воевода Mod 5) 10 MIRVed 750 KT warheads
Road Mobile Topol Sickle Launch
RT-23 / SS-24 Scalpel ICBMs had 10 MIRV warheads with design yields of 550 KT. The system was extremely heavy, so heavy that it caused extensive rail damage when deployed. This problem likely was one reason the Russians agreed to retire the RT-23 under the SALT agreement.
Deputy Defense Minister Yury Borisov announced that the Moscow Institute of Thermal Technology (MITT) was developing a new, lighter weight rail-mobile ICBM system, permitted with the end of START. This upgrade eliminates the damage to railroads caused by the RT-23. According to public Russian statements, the nuclear warheads will be of a new design that will be significantly hardened to nuclear effects.
RS-24 Yars (NATO SS-29) is heavier than the Topal-M and can be deployed in both silo and road mobile. Yars could be capable of delivering 10 independently targetable RVs and entered service July 2010.
Per Russian Strategic Missile Force Commander, Lt. Gen. Sergei Karakayev, Russia plans to replace its single-warhead mobile RS-12M2 Topol-M intercontinental strategic missile system with a new Topol missile that can carry up to four, independently-targeted, nuclear warheads.
The New Roadmobile
Version of the RS-24 Yars
Delta IV SSBN

139m long/12m beam

Yekaterinburg
Delta IV SSBN
Delta IV SSBN (involved in Murmansk Fire, 29 Dec 2011)
Project 941
Akula,
SS-N-20 Missiles

Typhoon Class SSBN

175m long/23m beam

R-27 SS-N-6
R-29 SS-N-8
R-29R SS-N-18
R-29RM SS-N-23
R-39 SS-N-20
New Borei-Class SSBN and New Bulava SLBM

170m long/13.5m beam

Bulava-30 SLBM

Automobile
2013 Major Russian Strategic Exercises

30 October 2013: Exercise included S-300 and S-400 defense systems; launches of 2 ICBMs (Topol and SS-18); 2 SLBMs; 4 SRBMs (Islander (1) and Tochka-U (3)); 6 TU-95M and 2 TU-160 flights to Venezuela.

President Putin was personally involved in the exercises.
2008 Faker tracks resume to test and evaluated US defense posture and capabilities

2009 Russian nuclear submarine patrols off US coasts resume (Sierra-2)
The Russian nuclear weapons complex has downsized while modernizing within a smaller and more efficient footprint.

Emphasis is being placed on modernizing Russian nuclear warheads, missiles, and serial production capacities.

Significant year-around experimentation with very large parks of instrumentation vans is constantly occurred at the Novaya Zemlya UGT Site.

In late 2012, Russia ended the Nunn-Lugar program that had focused on safeguarding SNM and converting it to peaceful use.

The majority of funds in the ‘Russian’ defense program up through 2015 will be spent on modernizing Russian strategic nuclear forces.*

*Russian Deputy Defense Minister A. Moltensky