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SOVIET NUCLEAR PROGRAMS [redacted]

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DISCUSSION

AVAILABILITY OF FISSIONABLE MATERIALS FOR NUCLEAR WEAPONS

Plutonium. The USSR has large reactor complexes at Kyshtym in the Urals and at Tomsk in western Siberia. There is also a large nuclear complex at Dodonovo, north of Krasnoyarsk in central Siberia, which may have one or more reactors installed underground. The reactors at Tomsk probably went into operation late in 1966 and 1968, respectively, and represent the only addition to production reactor capacity in the past several years. Additional capacity may be under construction.

After 1974 annual Soviet production of plutonium in production reactors will increasingly be affected by current and future decisions and actions that we cannot now detect or confidently predict. Fulfillment of military needs and the increasing availability of plutonium from power and propulsion reactors might lead to the shutdown of a large portion of the Soviet production reactor capacity. Conversely, additional needs for reactor products, perhaps in connection with employment of large numbers of nuclear explosives for peaceful purposes or for weapons programs which we cannot now project, might lead to significant increases in annual rates of production after 1974.

The Soviets also produce plutonium in a growing number of power and propulsion reactors. This plutonium could be used in nuclear weapons by blending it with material from production reactors or by appropriate choice of weapon designs. The Soviets probably are more likely--at least during the next five years--to accumulate their relatively small stocks of plutonium produced in power and propulsion reactors to meet future needs for fast breeder reactor fuel. After 1974 the rapidity with which the cumulative plutonium production from power reactors grows will depend entirely upon the pace and extent of their power and propulsion programs.

U-235. The USSR has four large gaseous diffusion complexes for the production of uranium enriched in U-235: Verkhne-Neyvinsk in the Urals, Tomsk in western Siberia, and Angarsk and Zaozerniy in central Siberia. Construction at Zaozerniy probably is nearing completion. There is no evidence of initiation of new construction of major U-235 production facilities.

The Soviets may be experimenting on a pilot-plant scale with the gas centrifuge process for enrichment of uranium, but this is highly speculative.

Although present Soviet U-235 production capacity could probably satisfy their internal needs, worldwide needs for U-235 or for uranium enrichment services are expected to grow rapidly in the latter part of the 1970's. A Soviet entry into this market could generate significant demands on their separative capacity and perhaps lead to modernization and expansion of their plants.

The Soviets do not put all their fissionable materials into weapons. The principal non-weapons use of U-235 is in propulsion systems in nuclear submarines, and in other power, propulsion, and research reactors that require uranium enriched in U-235. These non-weapons uses and losses probably do not now amount to more than about five percent of the total cumulative production of U-235; however, the share is likely to grow in the future. The non-weapons uses of plutonium are negligible; considering the plutonium available from power reactors, it is doubtful that the Soviets would have to use plutonium from production reactors for non-weapons uses in the future.

PEACEFUL USES

The use of nuclear energy for peaceful purposes has also taken a share of the R&D and material resources put into Soviet nuclear energy programs. The nuclear electric power program has been moving forward, but at a much slower pace than the Soviets originally publicized. In contrast, their unpublicized program for the peaceful uses of nuclear explosives is an area in which they lead the world in most applications. The Soviets apparently intend to enter the free world market for nuclear electric power stations and nuclear explosive services.

Power and Dual-Purpose Reactors

The Soviet nuclear power program announced in 1956 called for electric generating capacity of 2,000-2,500 megawatts (MWe) by 1960. It now appears it will reach a capacity of 2,000 MWe in 1970. During the past two years the Soviets have placed in operation the second section of the

Beloyarsk nuclear power station, a new section of the Tomsk dual purpose reactor complex, and the experimental sodium fast test reactor at Melekess. Construction has continued on schedule on the second section of the Novovoronezh nuclear power station, and the packaged power reactors at Bilibino. However, construction has fallen a year behind schedule on the sodium fast reactor for desalination and power at Shevchenko. Capacity has now reached 540 MWe in reactors primarily for production of electricity, 1,300 MWe in the dual purpose Siberian Nuclear Power Station at Tomsk, and over 60 MWe in stations at experimental reactor centers.

The Soviets have evidently overcome the engineering problems encountered earlier in their power program. They have in the past two years started construction on three types of a third generation of nuclear power station. They now apparently expect to double their nuclear generating capacity by 1975, and double it again by 1980 or so, so that by the latter date they will have some 8,000 MWe of nuclear generating capacity. With the construction of these larger plants, they expect to be able to compete with thermal power stations in high cost areas. With the construction of fourth generation plants, including fast breeder reactors with a generating capacity of 1,000 MWe or larger in the 1980's, they expect nuclear power to be fully competitive.

The main new construction program is based on the development of pressurized water reactors (PWR) at the Novovoronezh nuclear power station. The Soviets have been able to upgrade the first reactor to a power level of 278 MWe. Their second unit is expected to become operational in late 1969 and should reach 365 MWe.

Utilizing the experience gained from these two units, the Soviets have designed a "standard" 440 MWe pressurized water reactor (PWR) unit. Two of these standard units would be put together to make a standard PWR nuclear power station with a capacity of 880 MWe. Construction on the first unit of such a station has begun at Novovoronezh and in the Kola power system near Murmansk; the Soviets say they expect to build a similar power station near Yerevan.

The Soviets are attempting to enter the world power market with the 880 MWe PWR power station. They have started

construction of such a station in East Germany; they have signed agreements to construct similar stations in Hungary, Bulgaria, and Finland; and they are carrying out a cost study for a 440 MWe station of this type in East Pakistan. These stations will probably be built widely in Soviet Bloc countries, but indications of plans for sales elsewhere are limited. The Soviets will probably provide enrichment uranium feed to nuclear power stations built within the Bloc. Their entry into the world market for enriched uranium feed probably would depend upon political rather than economic considerations. They have indicated informally that they would meet the US price, although we believe their production costs are higher.

The Soviets are also planning to build nuclear power stations using two graphite moderated, water cooled reactors, with a station capacity of 2,000 MWe. The prototype for these stations is probably the Tomsk dual purpose reactor. The first of these stations is under construction near Leningrad; the Soviets have said they plan to build a similar station near Kursk.

The fast breeder reactor program is receiving heavy emphasis and greater publicity, but is apparently also encountering substantial difficulties. Two large fast breeder reactor power stations are under construction--a power and desalination facility at Shevchenko on the eastern shore of the Caspian Sea, with a planned capacity of 150 MWe and 32 million gallons of fresh water per day, and a 600 MWe power station at Beloyarsk. Both reactors will start with enriched uranium fuel, but are expected to use plutonium fuel in the future. These reactors, which are bold extrapolations of existing technology will, if successful, be major steps toward the development of 1,000-2,000 MWe fast breeder nuclear power stations.

MARINE PROPULSION

The pressurized water type reactors of the early Soviet nuclear submarines built in the late 1950's apparently had problems. Operating levels were limited to a thermal output of about 90 megawatts (MWt), judging from the speeds observed during the first few years of operation. Modifications made during the early to mid-1960's apparently overcame these limitations. Observed speeds of some of these early submarines in the last few years, along with theoretical calculations, indicate that these improved submarines have

propulsion plants of about 30,000 shaft horsepower, equating to an operating level on the order of 150 MWt. This is probably close to the capacity originally intended. Preliminary information on the new nuclear powered submarines now entering the fleet indicates that they have at least an equivalent shaft horsepower, and by implication, reactor power.

The nuclear icebreaker Lenin has not been in operation since the 1965 navigational season. Following an apparent nuclear accident, repair and modernization that involves extensive work in the reactor area is now in progress at Severodvinsk. Improved fuel element technology reported by the Soviets in 1966 and 1968 is expected to be incorporated into the Lenin's new reactor systems.