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3 March 1967

MEMORANDUM FOR: Chief, Nuclear Energy Division, OSI

FROM: Chief, Fuels and Power Branch, OPR

SUBJECT: Contribution to NIE 11-2-67, Soviet Atomic Energy Program

1. Attached are materials prepared as partial responses to paragraphs II D and II E of the terms of reference dated 24 February. It is suggested that the attached materials might be regarded as revision and expansion of thoughts now contained in paragraph 11 and paragraph 12 of the JAEIC Report 3-67, and that they might be inserted in the JAEIC report at those points.
2. The material on economic aspects of the nuclear electric power program was prepared by _____ and the material on Soviet aid to other countries was prepared by _____

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Soviet Atomic Energy Program

11. The Soviet nuclear power program announced in 1956 called for the generation of 2,000 megawatts of electricity by 1960. Progress toward this goal was very slow, and in 1957 the period was extended to 1965. By 1965, the total generating capacity at nuclear powerplants had only reached about 1,000 megawatts, and the date for attaining 2,000 megawatts had been extended to 1970. The size of the individual nuclear powerplants constructed up to the present time has been reduced considerably from the original plans. In addition to slow technological development, economic factors have been a major consideration in slowing down the Soviet nuclear power program. The Deputy Prime Minister for Science and Technology recently stated that no more nuclear power stations will be built for five years, because they are uneconomic. The cost of constructing the present Soviet nuclear powerplants turned out to be much higher than was originally estimated. The capital investment per megawatt in the Beloyarsk AEB reportedly was six times the comparable investment in a 200 megawatt conventional thermal powerplant, and at present the construction costs of nuclear powerplants are two to three times higher than for coal-fired powerplants of comparable capacity. The Minister of Power and Electrification stated that there had been no rapid development of nuclear power generation in the USSR during the past seven-year period because the cost of nuclear fuel was very high.

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11a. It is expected that the cost of producing power in nuclear powerplants will be lowered with the construction of larger units, and the overcoming of some of the technical problems. The Kharkov turbo-generator plant is at present working on designs for 200-500 mw turbines for nuclear powerplants. Soviet scientists believe that in the near future nuclear powerplants of 500 mw or more will be competitive with conventional powerplants in the European part of the USSR, where the demand for electric power is great, and the conventional fuel resources are inadequate. Tentative consideration is being given to the construction over the next ten years of nuclear powerplants in the Western part of the USSR, the Ukraine, and the Baltic Republics. It is estimated that in 1966 about one percent of the electric power produced in the USSR was generated at nuclear powerplants. Soviet sources have stated that by the year 2000, because of the limitations of conventional fuel supplies, at least one-third of all electric power will have to be generated by nuclear energy, or other novel means.

26. Soviet assistance to foreign countries in the construction of nuclear powerplants thus far has been restricted to the 70 mw Rheinsberg station in East Germany and the 150 mw station in Czechoslovakia. Numerous difficulties experienced in the construction of these stations resulted in repeated postponements of completion dates. Work on these stations started in 1958 and operation was originally scheduled for 1961-62, but Rheinsberg did not begin to generate power until May 1966

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and Bohunice will not be operating until 1970. Both plants are regarded as prototypes for larger ones that are in the design stage.

26a. It appears that the USSR is interested in becoming a supplier of nuclear powerplant equipment and fuel in the world market. An agreement was signed with East Germany in 1965 to provide assistance in the construction of additional nuclear powerplants, and the USSR has offered to assist Czechoslovakia in future construction of nuclear powerplants. Late in 1966 agreements were signed for Soviet participation in the construction of a nuclear powerplant in Hungary and another in Bulgaria, each of which will have two 400 mw reactors. Operation of both plants is scheduled for the years 1973-75. A bid has been tendered for a 300 mw plant in Finland, and recently there have been tentative discussions concerning possible Soviet assistance to India in constructing a nuclear powerplant at Madras. The development of the foreign market for power reactors, which may expand considerably, portends a growing demand for U235 and possible Soviet stockpiling for this purpose.

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Capital and Generating Costs at Soviet Nuclear Powerplants

The IBER has reported that the installed costs of the first nuclear power generating units at the Beloyarsk (100 mwe) and Novo-Voronesh (210 mwe) stations were, respectively, 530 rubles/kw^{1/} and 327 rubles/kw.^{2/} At the official exchange rate, these costs are equivalent to \$588/kw and \$363/kw, placing the total investment in Beloyarsk at \$58.8 million and in Novo-Voronesh at \$76.2 million. Presumably, these data represent construction costs only, exclusive of R & D, and may not include the cost of the first core. Undoubtedly, the costs of the stations would have been much greater were it not for the fact that considerable R & D costs were absorbed in the military nuclear program. Soviet estimates for costs of the second units at Beloyarsk (200 mwe) and Novo-Voronesh (365 mwe) are, respectively, 350 rubles/kw^{3/} and 192 rubles/kw,^{4/} equivalent to \$388.5/kw and \$213/kw. Total investments in the second units are the same at both plants -- \$77.7 million. The reduction in costs per kilowatt for the second units can be attributed partly to the usual economies resulting from constructing larger equipment and the probability that the investments in the first units included the cost of necessary support facilities. While the costs for these nuclear plants are substantially greater than for coal burning plants, which for similar size can be built for 100-110 rubles/kw

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in the USSR, ^{5/} they are not out of line with the early plants built in other countries. However, some very large conventional thermal plants in the USSR have been built for as little as 60 rubles (\$66)/kw. ^{6/}

The generating cost for the first unit at Beloyarsk is estimated at 1.9 kopecks (over 20 mills US)/kwh, ^{7/} nearly double the cost ^{of} 1 kopeck (11 mills US)/kwh for the first plant at Novo-Voronozh. ^{8/} The difference reflects not only the higher amortization charges for Beloyarsk, but also the higher cost of fuel, which is 1.5-2.0 times as expensive as the fuel used at Novo-Voronozh. ^{9/} Power costs for the second units are expected to decline to 0.8 kopecks (9 mills) at the Beloyarsk plant and 0.6 kopecks (6.6 mills)/kwh at Novo-Voronozh. The average cost of power generation at thermal plants in the USSR was 0.681 kopecks/kwh or about ^{7.5} 7 mills US in 1964. ^{10/}

The USSR expects to make substantial reductions in capital costs of nuclear powerplants by building reactors with capacities of 400 to 1,000 mw. This will contribute to lower generating costs through reduced charges for amortization. Higher burnup of fuel will also result in lower generating costs. The USSR anticipates that the cost of generating power in future powerplants equipped with fast breeder reactors may be less than 0.4 kopecks (4.4 mills)/kwh. ^{11/}

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SOURCE REFERENCES

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7. Malent'yev and Shteinguz, op. cit.
8. Soviet Atomic Energy, Oct 64, p. 975. U.
9. Third UN International Conference on the Peaceful Uses of Atomic Energy, Geneva, May 64, A/Conf. 23/7/294, p. 19. U.
10. Ibid.
11. USIAC, WASH-1060, p. 27. U.
12. A. Ya. Avrukh, Problemi Sabestoinosti, Elektricheskoy i Teplovooy Energii, 1966, p. 171. U.
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