

22541

6005245 UNCLASSIFIED CIA/SE 77-10082-14
SI M 77-10082

OSI/NED contribution to
USSR Energy Atlas

MICROFILMED

29 Aug 77

MICRO ONLY

The Soviet Nuclear Power Program

The Soviet nuclear power program has two basic types of nuclear power reactors in its inventory at the present time-- the pressurized-water reactor (PWR) and the channel-type boiling water reactor (BWR). In addition, the Soviets are currently in the process of introducing the liquid-metal fast breeder reactor (LMFBR) into their reactor inventory.

The current Soviet nuclear reactor construction program is based on three reactors. The VVER-440, a medium-sized PWR, is in serial production in the Soviet Union. The VVER-440 has a gross electrical capacity of 440 megawatts (MWe) and is the standard Soviet PWR design both for export and for domestic power production (figure 1). The Soviets have sold 26 of these reactors for export, almost entirely to the Eastern European countries. The VVER-1000 is a large-sized PWR which incorporates more sophisticated technology and safety features than does the VVER-440. The VVER-1000 is a scaled-up version of the VVER-440 PWR and has a gross electrical capacity of 1000 MWe. The Soviets are obviously making some concessions to Western reactor safety standards. This is demonstrated by the fact that the VVER-1000 will be the first Soviet PWR to utilize a Western-style secondary containment building and an emergency core cooling system (ECCS). Serial production of the VVER-1000 is beginning, and this reactor probably will become the standard

UNCLASSIFIED

GLAE
6005245

(9)

Soviet PWR in the near future. The RBMK-1000 is a large channel-type BWR and is the most sophisticated reactor of this type in the Soviet Union. It has a gross electrical capacity of 1000 MWe. One of the principle advantages of this type of reactor is that it allows for on-line refueling; i.e. the RBMK-1000, unlike Soviet PWRs, can operate at full power while its nuclear fuel is recharged.

Although the USSR was the first country in the world to build a power reactor, the Soviet nuclear power program has not progressed as rapidly as one would have expected. As of July 1977, the Soviet Union had an installed nuclear-electric generating capacity of only 7073 megawatts-electric. The Soviets have some 19,800 MWe of nuclear-electric generating capacity in various stages of construction at the present time and at least 11,000, and perhaps as much as 23,000, MWe of nuclear capacity is in an advanced stage of planning (table 1/). the locations of all the Soviet nuclear power stations--either operating under construction, or planned for construction to begin during the current Five-Year Plan--are shown in figure 2. An additional 13 nuclear power stations (26,000-30,000 MWe) are known to be in the planning stage but construction at these sites is not expected to begin until the next Five-Year Plan (1981-1985).

In addition to the reactors which are in operation or under construction, the USSR has a number of other reactors

under development. These include larger, 1500-MWe versions of the channel-type BWRs (RBMK-1500) and PWRs (VVER-1500) and large LMFBRs. Construction of the first nuclear power plant utilizing a RBMK-1500 reactor has begun in Lithuania. The design of the VVER-1500 is not as far along. The USSR has one LMFBR in operation, the BN-350, near Shevchenko on the Caspian Sea. A larger LMFBR with an alternate design is under construction near Beloyarsk. Soviet LMFBR research work is directed towards the production of a large, 1000 to 1600 MWe LMFBR.

The Soviet Union is among the many nations concerned about meeting their long-range energy needs. To meet the growing demands for electricity in the USSR, especially in the European part of the country, nuclear power stations are planned to offset a possible depletion of fuel for conventional power stations. At present, the Soviets' primary energy problem is one of distribution. About 85 percent of the Soviet fuel and hydro resources lie in Siberia, while about 80 percent of the electric power is consumed in the European part of the USSR. As the fossil fuel reserves in the European part of the USSR become depleted, nuclear power stations will become more competitive with conventional power stations, and the emphasis on nuclear power will increase.

By the end of 1975, the Soviet Union had an installed nuclear-electric generating capacity of 5,621 MWe. The Tenth

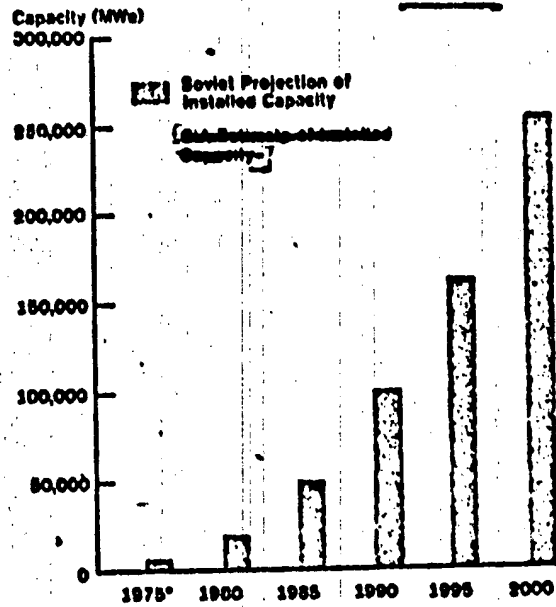
UNCLASSIFIED

Five-Year Plan calls for the completion of an additional 13,800 MWe of nuclear-electric generating capacity by the end of 1980. An installed capacity of 100,000 MWe is planned for 1990. The Soviets predict that by the year 2000, nuclear power will account for 30 to 35 percent of total Soviet electric power generating capacity. This represents about 255,000 MWe of nuclear-electric generating capacity at that time (figure 3/). Soviet projections for nuclear power appear to be rather optimistic. It is likely that future Soviet projections will be scaled down, and it would not be surprising if the Soviet projected nuclear power program fell several years behind schedule.

- 4 -

UNCLASSIFIED

Figure 3



*Figures for 1975 are the actual installed nuclear-electric generating capacity.

17275 5-77 CIA

Figure 3 Projected Soviet Nuclear-Electric Generating Capacity (UNCLASSIFIED)

Table 11

Nuclear Power Reactors in Operation, under Construction,

Item No.	Plant Designation	Location	Type of Plant	Elect. Capacity (MW)
1	Troitsk 1	Siberia	Graphite/Water	100
2	Troitsk 2	Siberia	Graphite/Water	100
3	Troitsk 3	Siberia	Graphite/Water	100
4	Troitsk 4	Siberia	Graphite/Water	100
5	Troitsk 5	Siberia	Graphite/Water	100
6	Troitsk 6	Siberia	Graphite/Water	100
7	Beloyarsk 1	Beloyarsk	BWR (channel-type)	100
8	Beloyarsk 2	Beloyarsk	BWR (channel-type)	200
9	Beloyarsk 3 (BN-600)	Beloyarsk	LMFBR	600
10	Novovoronezh 1	Novovoronezh	PWR	210
11	Novovoronezh 2	Novovoronezh	PWR	365
12	Novovoronezh 3	Novovoronezh	PWR	440
13	Novovoronezh 4	Novovoronezh	PWR	440
14	Novovoronezh 5	Novovoronezh	PWR	1000
15	BN-350	Shevchenko	LMFBR	350
16	Bilibino 1	Chukotka	BWR (channel-type)	12
17	Bilibino 2	Chukotka	BWR (channel-type)	12
18	Bilibino 3	Chukotka	BWR (channel-type)	12
19	Bilibino 4	Chukotka	BWR (channel-type)	12
20	Kola 1	Kola Peninsula	PWR	440
21	Kola 2	Kola Peninsula	PWR	440
22	Kola 3	Kola Peninsula	PWR	440
23	Kola 4	Kola Peninsula	PWR	440
24	Leningrad 1	Sosnovyy Bor	BWR (channel-type)	1000
25	Leningrad 2	Sosnovyy Bor	BWR (channel-type)	1000
26	Leningrad 3	Sosnovyy Bor	BWR (channel-type)	1000
27	Leningrad 4	Sosnovyy Bor	BWR (channel-type)	1000
28	Oktemberyan 1	Armenia	PWR	440
29	Oktemberyan 2	Armenia	PWR	440
30	Kursk 1	Kursk	BWR (channel-type)	1000
31	Kursk 2	Kursk	BWR (channel-type)	1000
32	Kursk 3	Kursk	BWR (channel-type)	1000
33	Kursk 4	Kursk	BWR (channel-type)	1000
34	Chernobyl 1	Chernobyl	BWR (channel-type)	1000
35	Chernobyl 2	Chernobyl	BWR (channel-type)	1000
36	Chernobyl 3	Chernobyl	BWR (channel-type)	1000
37	Chernobyl 4	Chernobyl	BWR (channel-type)	1000
38	Smolensk 1	Smolensk	BWR (channel-type)	1000
39	Smolensk 2	Smolensk	BWR (channel-type)	1000
40	Smolensk 3	Smolensk	BWR (channel-type)	1000
41	Smolensk 4	Smolensk	BWR (channel-type)	1000
42	West Ukraine 1	Rovno	PWR	440
43	West Ukraine 2	Rovno	PWR	440
44	West Ukraine 3	Rovno	PWR	1000

Table 1

Reactors in Operation, under Construction, and Planned

<u>Location</u>	<u>Type of Plant</u>	<u>Electric Capacity (MWe)</u>	<u>Year in Operation</u>
Siberia	Graphite/Water	100	1958
Siberia	Graphite/Water	100	1958
Siberia	Graphite/Water	100	1958
Siberia	Graphite/Water	100	1958
Siberia	Graphite/Water	100	1958
Siberia	Graphite/Water	100	1963
Beloyarsk	BWR (channel-type)	100	1964
Beloyarsk	BWR (channel-type)	200	1967
Beloyarsk	LMFBR	600	UC ^v
Novovoronezh	PWR	210	1964
Novovoronezh	PWR	365	1959
Novovoronezh	PWR	440	1971
Novovoronezh	PWR	440	1972
Novovoronezh	PWR	1000	UC
Shevchenko	LMFBR	350 ^{kt} [equivalent]	1973
Chukotka	BWR (channel-type)	12	1973
Chukotka	BWR (channel-type)	12	1974
Chukotka	BWR (channel-type)	12	1975
Chukotka	BWR (channel-type)	12	1976
Kola Peninsula	PWR	440	1973
Kola Peninsula	PWR	440	1974
Kola Peninsula	PWR	440	UC
Kola Peninsula	PWR	440	UC
Sosnovyy Bor	BWR (channel-type)	1000	1974
Sosnovyy Bor	BWR (channel-type)	1000	1975
Sosnovyy Bor	BWR (channel-type)	1000	UC
Sosnovyy Bor	BWR (channel-type)	1000	UC
Armenia	PWR	440	1977
Armania	PWR	440	UC
Kursk	BWR (channel-type)	1000	1977
Kursk	BWR (channel-type)	1000	UC
Kursk	BWR (channel-type)	1000	Planned
Kursk	BWR (channel-type)	1000	Planned
Chernobyl	BWR (channel-type)	1000	UC
Chernobyl	BWR (channel-type)	1000	UC
Chernobyl	BWR (channel-type)	1000	Planned
Chernobyl	BWR (channel-type)	1000	Planned
Smolensk	BWR (channel-type)	1000	UC
Smolensk	BWR (channel-type)	1000	UC
Smolensk	BWR (channel-type)	1000	Planned
Smolensk	BWR (channel-type)	1000	Planned
Rovno	PWR	440	UC
Rovno	PWR	440	UC
Rovno	PWR	1000	Planned

28	Oktemberyan 1	Armenia	PWR	440
29	Oktemberyan 2	Armania	PWR	440
30	Kursk 1	Kursk	BWR (channel-type)	1000
31	Kursk 2	Kursk	BWR (channel-type)	1000
32	Kursk 3	Kursk	BWR (channel-type)	1000
33	Kursk 4	Kursk	BWR (channel-type)	1000
34	Chernobyl' 1	Chernobyl'	BWR (channel-type)	1000
35	Chernobyl' 2	Chernobyl'	BWR (channel-type)	1000
36	Chernobyl' 3	Chernobyl'	BWR (channel-type)	1000
37	Chernobyl' 4	Chernobyl'	BWR (channel-type)	1000
38	Smolensk 1	Smolensk	BWR (channel-type)	1000
39	Smolensk 2	Smolensk	BWR (channel-type)	1000
40	Smolensk 3	Smolensk	BWR (channel-type)	1000
41	Smolensk 4	Smolensk	BWR (channel-type)	1000
42	West Ukraine 1	Rovno	PWR	440
43	West Ukraine 2	Rovno	PWR	440
44	West Ukraine 3	Rovno	PWR	1000
45	Kalinin 1	Kalinin	PWR	1000
46	Kalinin 2	Kalinin	PWR	1000
47	Ignalina 1	Lithuania	BWR (channel-type)	1500
48	Ignalina 2	Lithuania	BWR (channel-type)	1500
49	South Ukraine 1	Nikolayev	PWR	1000
50	South Ukraine 2	Nikolayev	PWR	1000
51	South Ukraine 3	Nikolayev	PWR	1000
52	South Ukraine 4	Nikolayev	PWR	1000
53	Urals 1	Urals	BWR (channel-type)	1000
54	Urals 2	Urals	BWR (channel-type)	1000
55	Ivano-Frankovsk 1	Ukraine	BWR (channel-type)	1000
56	Ivano-Frankovsk 2	Ukraine	BWR (channel-type)	1000
57	Khmel'nitskiy 1	Ukraine	Unknown	Unknown
58	Khmel'nitskiy 2	Ukraine	Unknown	Unknown
59	Aktash 1	Crimea	Unknown	Unknown
60	Aktash 2	Crimea	Unknown	Unknown
61	Saratov 1	Saratov	Unknown	Unknown
62	Saratov 2	Saratov	Unknown	Unknown
63	Tsimlyansk 1	Volgodonsk	Unknown	Unknown
64	Tsimlyansk 2	Volgodonsk	Unknown	Unknown

NOTE: ^{13 nuclear power stations} An additional 26 reactors are known to be in the planning stage but construction expected to begin on these reactors until the next Five-Year Plan (1981-1985)

* UC = under construction

** This reactor has a rated capacity of 350 MWe; however, power to 200 MWe is utilized to generate water from the Caspian

Armenia	PWR	440	1977
Armania	PWR	440	UC
Kursk	BWR (channel-type)	1000	1977
Kursk	BWR (channel-type)	1000	UC
Kursk	BWR (channel-type)	1000	Planned
Kursk	BWR (channel-type)	1000	Planned
Chernobyl	BWR (channel-type)	1000	UC
Chernobyl	BWR (channel-type)	1000	UC
Chernobyl	BWR (channel-type)	1000	Planned
Chernobyl	BWR (channel-type)	1000	Planned
Smolensk	BWR (channel-type)	1000	UC
Smolensk	BWR (channel-type)	1000	UC
Smolensk	BWR (channel-type)	1000	Planned
Smolensk	BWR (channel-type)	1000	Planned
Rovno	PWR	440	UC
Rovno	PWR	440	UC
Rovno	PWR	1000	Planned
Kalinin	PWR	1000	UC
Kalinin	PWR	1000	UC
Lithuania	BWR (channel-type)	1500	UC
Lithuania	BWR (channel-type)	1500	UC
Nikolayev	PWR	1000	UC
Nikolayev	PWR	1000	UC
Nikolayev	PWR	1000	Planned
Nikolayev	PWR	1000	Planned
Urals	BWR (channel-type)	1000	UC
Urals	BWR (channel-type)	1000	UC
Ukraine	BWR (channel-type)	1000	Planned
Ukraine	BWR (channel-type)	1000	Planned
Ukraine	Unknown	Unknown	Planned
Ukraine	Unknown	Unknown	Planned
Crimea	Unknown	Unknown	Planned
Crimea	Unknown	Unknown	Planned
Saratov	Unknown	Unknown	Planned
Saratov	Unknown	Unknown	Planned
Volgodonsk	Unknown	Unknown	Planned
Volgodonsk	Unknown	Unknown	Planned

power stations

are known to be in the planning stage but construction is not
 to start until the next Five-Year Plan (1981-1985).

(USSR, etc.)

total capacity of 350 MWe; however, press steam equivalent
 to be distributed under from the Caspian Sea.