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ECONOMIC INTELLIGENCE COMMITTEE

SUBCOMMITTEE ON TRANSPORTATION

Project EIC-R9-S1

CAPABILITY OF THE TRANS-SIBERIAN RAILROAD

Final Draft of the

Transportation Capabilities Estimates Group

This study is based on information received to August, 1956.

14 August 1957

S-E-C-R-E-T

FOREWORD

The Trans-Siberian Railroad is the sole surface transportation artery connecting European USSR with the Soviet Far East and Communist China. An understanding of the capability of this railroad is important, therefore, in estimating the military and economic capabilities, intentions and vulnerabilities of the USSR and Communist China.

The first report prepared by the Subcommittee on Transportation on this subject was approved by the Economic Intelligence Committee and published as EIC R9, "Capability of the Trans-Siberian Railroad and Connecting Lines in Manchuria and Korea," on 23 March 1953. Since that time considerable additional information has become available and the Subcommittee on Transportation has improved its method of estimating the capability of railroad routes. The importance of this subject warrants the publication of a revised estimate at this time.

The Transportation Capabilities Estimates Group has been able to agree on the through capability of the Trans-Siberian Railroad and on all other major aspects of the problem. [redacted] 25X1 however, it has not been possible to achieve complete agreement on the specific capability of individual sectors of the through route. The points of difference and the reasons therefore are indicated in the footnote to Table I.

TABLE OF CONTENTS

25X1

Page

25X1

LIST OF TABLES

I. INTRODUCTION

The capability of the Trans-Siberian Railroad, the subject of this paper, is vital to the Soviet Union because of its political, economic, and strategic significance and is, therefore, of great concern to the entire free world.

For purposes of this study, the railroad is the 4,100 miles of double-track, 5'0" gauge main line which connects Omsk in Western Siberia and Vladivostok in the Soviet Far East. (See attached map.) It is the sole rail link connecting European USSR with the Soviet Far East and China. In addition, it is the major and in some cases the only link connecting the industrial centers in the Urals, Kuznets, and Central Siberia. The preponderance of traffic on this railroad moves between these industrial centers.

Soviet dependence on the Trans-Siberian is apparent when the tonnage-carrying capability of the railroad is compared with the insignificant tonnage moved over the Northern Sea Route, the only other Soviet controlled supply route with a through capability. No through roads nor inland waterway networks exist. In times of peace a large amount of bulk freight is moved through ocean shipping ports in European USSR to the Far East, but during periods of world tension or in time of war the Trans-Siberian is expected to bear the major part of the transportation burden. For this reason, up-to-date capability estimates of the Trans-Siberian are the concern of all United States Intelligence Agencies.

S-E-C-R-E-T

This study provides an estimate of the through tonnage capability of the railroad by sector under peacetime conditions for a sustained period of time. The term "through" is defined as traffic moving between the termini of the line, Omsk and Vladivostok, on the one hand, and Omsk and the connecting lines leading to Mongolia, Manchuria, and North Korea, on the other. The term "capability" is defined as the maximum performance which is attainable with existing facilities, technology and operating methods when the limitation of all contributing factors are considered. A capability estimate is, therefore, an average figure which can actually be obtained over a sustained period of time. The "sustained period of time" is considered as being a year or longer. In addition it is assumed that sufficient personnel, locomotives and freight cars are available for operation of the line at capability and that all trains operating are freight trains.

The methodology employed in the preparation of the estimate follows the procedure recommended in a working paper approved for testing by the Subcommittee on Transportation, "Agreed Methodology for Computing Capability for Through Freight Movement," 15 September 1955. As work progressed on this estimate, the methodology was expanded and, in part, modified.

25X1

S-E-C-R-E-T

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25X1

II. CAPABILITY OF THE TRANS-SIBERIAN RAILROAD

A. Through Capability

The Trans-Siberian Railroad, extending some 4,100 miles from Omsk in Western Siberia to Vladivostok in the Far East, is a vital transportation artery. The western section of the road between Novosibirsk and Omsk, where there is a preponderance of west-bound traffic movement, has the highest traffic density of any section of railroad in the USSR. The volume of westbound traffic drops off sharply east of Novosibirsk, but continues to exceed eastbound traffic at least as far east as Tayshet from which point eastbound traffic exceeds westbound traffic in volume.

USSR railroad officials are very concerned about the ability of the railroad to handle the anticipated increases in traffic and have made plans for the improvement of the railroad through electrification. Plans call for the electrification of the line as far east as Irkutsk by 1960, and intentions to electrify the entire line to Vladivostok by 1970 or 1975 have been announced. Electrification of the line from Omsk to Novosibirsk was completed at the end of 1956, but there is evidence that some steam motive power was being used on this stretch of the line during 1956 indicating difficulties in converting all operations on the line to electric traction.

The capability of the railroad varies throughout its length (See Table I) with the weakest portions of the railroad existing east of Tarskiy. At Tarskiy the line branches southward to the Manchurian border providing an alternate route to the Soviet Far East by way of the old Chinese Eastern Railroad.

Currently, there are four connecting railroads between the Trans-Siberian Railroad and Communist China. The first connects at Zaudinskiy (near Ulan Ude) just east of Lake Baikal with the Trans-Mongolian Railroad into China at Chining; the second connects at Tarskiy just east of Chita with the Manchurian railroads at Otpor - Manchouli; the third connects at Voroshilov, just north of Vladivostok, with the Manchurian railroads at Grodekovo - Suifenho; and the

S-E-C-R-E-T

fourth connects at Baranovskiy, just south of Voroshilov with the North Korean railroads and thence the Manchurian railroads at Hongui.

We estimate that the Trans-Siberian Railroad has the capability to move in the magnitude of 30,000 net short tons each way per day (EWPD) between Omsk and Vladivostok exclusively in USSR territory. Between Omsk and the connecting lines to Mongolia and Manchuria we estimate that 40,000 short tons EWPD can be moved. The estimated margin of error for these through capability figures is plus or minus 20 percent. Various sections of the line have a capability to move tonnages in excess of the stated amount.

B. Sector Capability

Table I shows the capability of each sector of the Trans-Siberian Railroad in terms of an optimum combination of single and double-headed freight trains to produce maximum tonnage, less two trains each way per day for operating requirements of the railroad. The capability for each sector is determined by the individual division within the sector which has the lowest capability (See Tables 3, 4, 5 and 6). The estimated margin of error for the sector figures below is plus or minus 20 percent.

TABLE I

Sector Capability of the Trans-Siberian Railroad for Freight Trains 1/ (Based on assumptions stated in the Introduction)

Sector	Freight Trains EWPD: Single headed	Double headed	Total	Tonnage per Train (Net Short Tons): Single headed	Double headed	Total Net Short Tons EWPD 2/
Omsk-Novosibirsk	43 3/	0	43 3/	2,320 3/	—	99,800 3/
	43 4/	0	43 4/	1,365 4/	—	58,700 4/
Novosibirsk-Achinsk	32	0	32	1,240	—	39,700
Achinsk-Tayshet	36	0	36	1,125	—	40,500
Tayshet-Irkutsk	19	12	31	1,005	1,810	40,800
Irkutsk-Slyudyanka	21 3/	10	31 3/	1,000 3/	2,000	41,000 3/
Slyudyanka-Zaudinskiy	23	8	31	1,085 5/	1,960 5/	40,600
Zaudinskiy-Tarskiy	31	3	34	1,025 5/	1,480 5/	36,200
Tarskiy-Skovorodino	26	0	26	1,170	—	30,400
Skovorodino-Arkhara	25	0	25	1,210	—	30,300
Arkhara-Khabarovsk I	11	8	19	1,250	2,250	31,800
Khabarovsk I-Vladivostok	29	0	29	1,025	1,840	29,700

1/ **In addition to the freight trains shown, each sector has the additional capability of handling two single-headed trains for railroad operation (including fuel) and maintenance.**

No deductions have been made for minimum essential freight or passenger traffic. A method for estimating these deductions is outlined in Annex I. (See I, A, 5, Method of computing total through capability for freight traffic).

2/ Rounded to nearest hundred.

3/ Based on electric operation.

4/ Based on steam locomotive operation.

5/ Includes use of helper steam locomotives over 1.74% grade.

Note: The CIA member is unable to concur in the estimates of the capability of the various railroad sectors contained in this report. Estimates of traffic moving westbound over the Omsk-Novosibirsk and Achinsk-Tayshet sectors exceed the capability given above despite the estimated margin of error. (See CIA/RR 82, The Volume and Character of Traffic on the Trans-Siberian Railroad in 1953, 9 November 1956). In view of the discrepancy between traffic estimates and capability estimated herein for these two sectors, CIA suggests that all sector capabilities may be low. Since the limitations of currently existing intelligence preclude the reconciliation of the traffic estimates with the capability estimates, the CIA member is prepared to accept the estimates of through capability, with the estimated margin of error contained in this report, as the best existing estimate.

III. Short Over-all Description of Lines and Areas Served

A. Geographic Description

The Trans-Siberian Railroad, for purposes of this study, is considered as being the double track railroad line running from Omsk to Vladivostok. It traverses a plain from Omsk to Novosibirsk and generally mountainous or hilly areas from Novosibirsk to Vladivostok. Most of the large cities served by the Trans-Siberian railroad, Omsk, Novosibirsk, Krasnoyarsk, Irkutsk, Ulan Ude, Khobarovsk, and Vladivostok, are situated at transshipment points where the railroad crosses or meets navigable waterways, the area's only other medium of large-scale transport. Manufacturing and the exploitation of mineral and lumber resources are the most important aspects of the economy along the railroad and are the major producers of freight traffic.

B. Technical Characteristics of the Line

The Trans-Siberian railroad is a double-tracked, 5' 0" gage line having light rail on its eastern portions. Rail weighing 101 pounds per yard is found between Omsk and Achinsk and rail weighing 77 pounds per yard predominates between Achinsk and Vladivostok. The Omsk-Novosibirsk and Irkutsk-Slyudyanka sectors are now electrified. Most of the yards are relatively small although there are a few large classification yards at major cities. Steam locomotive repair facilities are spaced between 50 and 110 miles apart and are also relatively small. There is automatic block signaling from Omsk to Achinsk (750 miles) and on the Irkutsk to Slyudyanka by-pass line (79 miles); for the purposes of this study, semi-automatic block signalling is assumed to be in operation from Achinsk to Irkutsk (790 miles); and station to station block from Slyudyanka to Vladivostok. (2,553 miles.)

C. Equipment

Electric and steam locomotives are employed on the Omsk-Novosibirsk sector and electric locomotives from Irkutsk to Slyudyanka; steam locomotives are used on the remaining sectors, with some heavier types used between Novosibirsk and Achinsk on the heavier rail. Freight cars in use are representative of the Soviet freight car park.

D. Traffic

Existing traffic on the line includes a very heavy movement of Kuznets coal westbound from Novosibirsk to Omsk, and much smaller but still significant tonnages moving both west and east from Cheremkhovo, east from Raychikhinsk, and west from the coal fields east of Vladivostok.

Other major movements include westbound Kuznets coke from Novosibirsk to Omsk, westbound timber and lumber beginning approximately at Petrovskiy-Zavod and increasing in volume westward to Novosibirsk where they drop off significantly; and agricultural, animal, and mineral products, particularly imports from China which reach the line at Tarskiy and flow westward to Omsk. The major eastbound commodity other than coal on certain sections is POL which moves from Omsk through to the Far East. Ferrous ores move east from Omsk to Novosibirsk for the Kuznets basin and ferrous products and scrap move in both directions in varying amounts on different sections; agricultural products move east from Omsk to the Far East.

25X1

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S-E-C-R-E-T

Table 2

TRANS-SIBERIAN RAILROAD

Estimated Line Capability for Freight Trains Based on Line Distance Between Signals

Sector	Max. Distance Between Signals or Block Stations (Miles)	Speed of Freight Train 1/ (MPH)	Running Time (Minutes)	Capability of line (TEWPD)	Reduced Capability of line 2/ (TEWPD)
Omsk-Novosibirsk	3.6 3/	19.3	11.2	128	102
Novosibirsk-Achinsk	3.6 3/	17.2	12.6	114	91
Achinsk-Tayshet	5.0 4/	15.9	18.9	76	61
Tayshet-Irkutsk I	7.2 4/	15.1	28.6	50	40
Irkutsk I-Slyudyanka	3.6 3/	15.6	13.9	103	82
Slyudyanka-Zaudinskiy	10.6	17.1	40.7	35 5/	28 5/
Zaudinskiy-Tarskiy	13.1	15.3	51.3	28 5/	22 5/
Tarskiy-Skovorodino	14.9	14.8	60.4	24 5/	19 5/
Skovorodino-Arkhara	13.1	16.6	47.4	30 5/	24 5/
Arkhara-Khabarovsk I	10.6	15.1	42.1	34 5/	27 5/
Khabarovsk I-Vladivostok	9.9	16.6	35.9	40 5/	32 5/

1/ Based on index numbers, obtained from 1956 timetable running speed (excluding scheduled stops) for the fastest passenger train, applied to a calculated 17.2 mph freight train speed for the Novosibirk-Achinsk sector (17.2 mph = 100). This 17.2 mph speed includes acceleration and braking factors for coal and water stops and breakdowns along the line. These index numbers, given in order for each sector listed, are as follows: 112, 100, 93, 88, 91, 99, 89, 86, 96, 88, 96. Time required for watering, coaling, inspecting and other delays was not considered in the calculation of this speed since such delay time is incurred at stations and does not affect line capability.

2/ Capability reduced by 20 percent to provide for unforseen delays occurring on the line between stations.

3/ Minimum distance between trains, based on maximum distance between automatic block signals of 1.8 miles, assuming trains maintain running speed on green aspect.

4/ Half the distance of the maximum station interval (assumed for purpose of this problem for semi-automatic block signals).

5/ From Slyudyanka to Vladivostok the capability was calculated on the use of absolute station to station block. If these sectors were operated under permissive block the capability figures would be significantly higher. For the purposes of this study, these sectors are assumed to be operated under permissive block conditions, and therefore signals do not limit line capability.

S-E-C-R-E-T

2. Capability of Yards

Table 3 shows data on type, size and capability of freight yards on the Trans-Siberian railroad. To aid in making the capability estimate, tracks in major yards were allocated to classification and relay functions to obtain maximum traffic through them. The figures on number of tracks in yards include those estimated to be available for relay and classification. It should be noted that in actual practice some of this trackage would also have to be used for local freight. At a number of points it is possible that the figures shown may not include all the freight yard trackage.

Capability of these yards was computed by assuming that each track could hold one train, whether single or double-headed, and by applying a daily turnover factor of 3 for classification tracks and 6 for relay tracks. This means that under maximum operation the average delay of a train is 8 hours when it undergoes classification and 4 hours when it is relayed. This includes the effects of train delays and the fact that not all tracks would be occupied by trains, since complete occupance of all tracks would preclude removal and storage of damaged cars or cars with freight destined for the region served by the yard in question.

3. Capability of Freight Locomotive Repair Facilities

Table 4 shows capability of steam locomotive repair facilities on the Trans-Siberian Railroad for freight locomotives. The number of stalls in sheds and roundhouses was estimated [redacted] 25X1
Deductions for branch lines were made on the basis of locomotive stall requirements to support a minimum essential level of traffic on these lines. Deductions of switch locomotives were based on the estimated relative levels of traffic which would be handled at the yards. The remaining stalls available for main line locomotives at each city were then allotted for movement in two directions from that city in such a way as to obtain an approximately equal number of stalls between succeeding cities. The capability of stalls to support trains between each two succeeding cities was determined by utilizing a daily stall turnover factor of 3.4 on all sectors except from Tarskiy to Khabarovsk

where a turnover factor of 2.0 was used for reasons stated in footnote 3 on Table 4. The turnover factor of 3.4 implies that each locomotive spends an average of 7 hours a day in sheds for servicing, running repairs, boiler washing, and medium repairs (but excluding capital repairs), or that an average of 29 percent of a locomotive's time is spent in sheds. The turnover factor of 2.0 implies that each locomotive spends an average of 12 hours a day in sheds, or that an average of 50 percent of its time is spent in sheds. The average of 7 and 12 hours a day spent in sheds is normally divided between the home depot and turnaround shed, with a minimum time per locomotive at any one shed of one hour.

Locomotive depots were given the capability of balancing motive power; i.e., they were assumed to be capable of dispatching locomotives in either direction. Turnaround points were not given this capability of balancing motive power, but were assigned the function of dispatching engines only back to the engine's home depot. At turnaround points the stalls were divided equally between the two directions in practically all instances.

It is assumed that, under capability operation, all repair plants on the Trans-Siberian would be used solely for the heavy repair of locomotives on the main and branch lines, and possibly also for some medium repair of branch line locomotives. Medium repairs of locomotives operating on the main line of the Trans-Siberian are assumed to be performed in locomotive depots. It is estimated that between 20 and 40 locomotives would be under capital repair at all times to operate the line at its capability. Known repair plants at Omsk, Novosibirsk, Krasnoyarsk, Ulan Ude and Voroshilov are able to handle an estimated 24 locomotives in their erecting shops simultaneously. Therefore, capital repair capability, although fully utilized, would not limit operation.

4. Sector Capability for Freight Trains

Table 5 shows the capability of each sector of the Trans-Siberian railroad, in terms of freight trains each way per day. The capability figures represent the number of trains which would be supported by the facility (locomotive repair facility, or yard) which has the lowest capability. The final columns show sector capability for freight trains EWPD after deduction from total sector capability of an estimated two single-headed freight trains EWPD for railroad supplies (coal, ties, ballast) and work trains.

5. Method of Computing Total Through Capability for Freight Traffic

Table 6 indicates the capability of each division to move freight trains and their total maximum net tonnage each way per day. To derive total through capability for freight traffic, the following procedure is recommended:

a. Subtract from this capability shown in Table 6 essential tonnage to sustain the local areas along the line, i.e., essential intra divisional traffic, essential originating traffic going to points outside the limits of the division, and essential terminating traffic from points outside the division limits.

b. The remainder is through freight traffic capability for each division.

c. From this figure must be subtracted essential passenger traffic in equivalent freight trains.

(1) Generally speaking a passenger locomotive should produce about twice the daily miles of a locomotive pulling freight trains of the size envisioned in this study. Therefore, the motive power requirements for passenger trains are assumed to be about 1/2 that of freight trains, i.e., 2 passenger trains can be moved by displacing 1 freight train when motive power is the limiting factor.

(2) Yard capabilities are not significantly affected by passenger trains. In large cities where the concentration of passenger coaches is heavy specialized passenger terminals are used.

d. The capability remaining after the equivalent tonnages of these trains (if any) have been deducted, is the actual through freight capability of each division.

e. The through freight capability of any sector cannot exceed its limiting division.

f. The through freight capability of the line cannot exceed the limiting sector.

Table 3
TRANS-SIBERIAN RAILROAD
Estimated Capability Based on Yards

Sector	Yard	Type	Estimated No. of Relay and/or Class. Tracks 1/	Turnover Factor per Track	Total Trains per Day	TEWPD For Sector
Omsk-Novosibirsk	Omsk 2/	Class.	18	3		
	Omsk	Relay	12	6	126	
	Tatarskaya	Class.	2	3		
	Tatarskaya	Relay	14	6	90	45
	Barabinsk	Relay	16	6	96	
	Chulymskaya	Relay	16	6	96	
	Novosibirsk 3/	Class.	40	3		
	Novosibirsk	Relay	35	6	330	
Novosibirsk-Achinsk	Bolotnaya	Relay	11	6	66 4/	
	Tayga	Class.	6	3		
	Tayga	Relay	9	6	72	31 4/
	Mariinsk	Relay	15	6	90	
	Bogotol	Relay	14	6	84	
Achinsk-Tayshet	Chernorechenskaya	Relay	16	6	96	
	Krasnoyarsk	Class.	15	3		
	Krasnoyarsk	Relay	10	6	105	
	Klyukvennaya	Relay	16	6	96	39
	Ilanskaya	Relay	13	6	78	
	Tayshet	Class.	3	3		
	Tayshet	Relay	13	6	87	
Tayshet-Irkutsk	Nizhneudinsk	Relay	13	6	78	
	Tulun	Relay	11	6	66	33
	Zima	Relay	18	6	108	
	Cheremkhovo	Relay	20	6	120	
	Irkutsk	Class.	16	3		
	Irkutsk	Relay	12	6	120	
Irkutsk-Slyudyanka	Slyudyanka	Relay	11	6	66	33

Table 3 (Continued)

Sector	Yard	Type	Estimated No. of Relay and/or Class. Tracks 1/	Turnover Factor per Track	Total Trains per Day	TEWPD For Sector
Slyudyanka-Zaudinskiy	Mysovaya	Relay	15	6	90	33 5/
	Ulan Ude	Class.	15	3		
	Ulan Ude	Relay	10	6	105	
Zaudinskiy-Tarskiy	Petrovskiy Zavod	Relay	12	6	72	
	Khilok	Relay	12	6	72	
	Mogzon	Relay	13	6	78	36
	Chita	Class.	15	3		
	Chita	Relay	10	6	105	
	Karymskaya	Relay	12	6	72	
Tarskiy-Skovorodino	Shilka	Relay	13	6	78	
	Kaganovich	Relay	12	6	72	
	Zilovo	Relay	16	6	96	
	Ksenyevkaya	Relay	20	6	120	33
	Mogocha	Relay	14	6	84	
	Amazar	Relay	11	6	66	
	Yerofey Pavlovich	Relay	13	6	78	
	Urusha	Relay	13	6	78	
	Skovorodino	Relay	13	6	78	
Skovorodino-Arkhara	Taldan	Relay	11	6	66	
	Magdagachi	Relay	9	6	54	
	Ushumun	Relay	13	6	78	
	Shimanovskaya	Relay	12	6	72	
	Svobodny	Relay	12	6	72	27
	Kuybyshevka-Vostochnaya	Class.	10	3		
	Kuybyshevka-Vostochnaya	Relay	10	6	90	
	Zavitaya	Relay	12	6	72	
	Bureya	Relay	10	6	60	
	Arkhara	Relay	10	6	60	
Arkhara-Khabarovsk	Obluchye	Relay	10	6	60	
	Bira	Relay	7	6	42	21
	In (Smidovich)	Relay	8	6	48	
	Khabarovsk	Class.	12	3		
	Khabarovsk	Relay	8	6	84	

-19-

Table 3 (Continued)

Sector	Yard	Type	Estimated No. of Relay and/or Class. Tracks[1]	Turnover Factor per Track	Total Trains per Day	EWPD For Sector
Khabarovsk-Vladivostok	Vyazemskaya	Relay	8	6	48	
	Bikin	Relay	9	6	54	
	Guberovo	Relay	9	6	54	
	Ruzhino	Relay	8	6	48	
	Yevgenyevka	Relay	11	6	66	24
	Voroshilov	Class.	12	3		
	Voroshilov	Relay	8	6	84	
	Pervaya Rechka	Class.	20	3	60	
	(Vladivostok)	Relay				

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Table 4

TRANS-SIBERIAN RAILROAD

Estimated Capability based on Freight Steam Locomotive Repair Facilities

Sector	Type of Facility: Locomotive Depot	Type of Facility: Locomotive Turnaround Point	Total Number of Locomotive Repair Stalls	Stalls Deducted For: Branch Lines	Stalls Deducted For: Switch Loco's	Stalls Available for Main Line Loco's	Stalls Allotted for Turnaround Section or Division	Main Line Loco's Which Allotted Stalls Could Support per 24 hrs	TEWPD Which Could be Supported by These Locomotives: Single-headed	TEWPD for Sector Which Could be Supported by Limiting Sheds: Single-headed
Omsk-Novosibirsk	Omsk		38	20	4	14	14	54	54	
							2			
		Tatarskaya	6	1	1	4				
							2			
	Barabinsk		22	0	1	21	21	90	45	
							3.5			
		Chulymskaya	8	0	1	7			45	45
							3.5			
Novosibirsk-Achinsk	Novosibirsk		32	8	4	20	12.0	53	53	
							8.0			
		Bolotnoya	18	4	1	13	6.5	49	49	
							6.5			
	Tayga		16	4	2	12	6.0	43	43	
							6.0			
		Mariinsk	12	0	1	11	5.5	39	39	34
							5.5			
	Bogotol		12	0	1	11	11	68	34	
							3.5			
Achinsk-Tayshet		Chernorechenskaya	8	1	0	7			34	
							3.5			
	Krasnoyarsk		24	3	5	16	16	76	38	38
							3		38	

SECRET

Table 4 (Continued)

TRANS-SIBERIAN RAILROAD

Estimated Capability based on Freight Steam Locomotive Repair Facilities

Sector	Type of Facility: Locomotive Depot	Type of Facility: Locomotive Turnaround Point	Total Number of Locomotive Repair Stalls	Stalls Deducted For: Branch Lines	Stalls Deducted For: Switch Loco's	Stalls Available for Main Line Loco's	Stalls Allotted for Turnaround Section or Division	Main Line Loco's Which Allotted Stalls Could Support per 24 hrs	TEWPD Which Could be Supported by These Locomotives: Single-headed	TEWPD for Sector Which Could be Supported by Limiting Sheds: Single-headed
		Klyukvennaya	6	0	0	6				
							3		54	
	Ilanskaya		26	1	1	24	24	108		
							5		54	
Tayshet-Irkutsk		Tayshet	12	1	1	10				
							5		45	
	Nizhneudinsk		18	1	1	16	16	90		
							5.5		45	
		Tulun	12	0	1	11				45
							5.5		58	
	Zima		24	0	1	23	23	116		
							5.5		58	
		Cheremkhovo	14	1	2	11				
							5.5			
							10	53	53	
Irkutsk-Slyudyanka	Irkutsk		32	4	8	20				
							10			
							2	41	41	41
Slyudyanka-Zaudinskiy	Slyudyanka	Slyudyanka	12	1	1	10				
							8			
							4	41	41	
		Mysovaya	12	0	1	11				
							7			41
							5	41	41	
	Ulan Ude		18	2	6	10				
							5			
							4.5	39 1/	39	

Table 4 (Continued)

TRANS-SIBERIAN RAILROAD

Estimated Capability based on Freight Steam Locomotive Repair Facilities

Sector	Type of Facility: Locomotive Depot	Type of Facility: Locomotive Turnaround Point	Total Number of Locomotive Repair Stalls	Stalls Deducted For: Branch Lines	Stalls Deducted For: Switch Loco's	Stalls Available for Main Line Loco's	Stalls Allotted for Turnaround Section or Division	Main Line Loco's Which Allotted Stalls Could Support per 24 hrs	TEWPD Which Could be Supported by These Locomotives: Single-headed	TEWPD for Sector Which Could be Supported by Limiting Sheds: Single-headed
Zaudinskiy-Tarskiy										
		Petrovskiy Zavod	10	0	1	9				39
							4.5		64	
	Khilok		28	0	1	27	27	128		
							6		64	
		Mogzon	12	0	0	12				
							6		65	
	Chita		36	4	8	24	24	131 2/		
							8.5		65	
		Karymskaya	24	6	1	17				
Tarskiy-Skovorodino							8.5		33	
	Shilka		18	0	1	17	17	66 3/		
							7.5		33	
		Kaganovicha	18	2	1	15				
							7.5		42	
	Zilovo		32	0	2	30	30	85 3/		
							5		42	
		Ksenyevkaya	10	0	0	10				
							5		32	28
	Mogocho		22	0	1	21	21	63 3/		
							5.5		32	
		Amazar	12	0	1	11				
							5.5		28	
	Yerofey Pavlovich		18	0	1	17	17	56 3/		
							5.5		28	
		Urusha	12	0	1	11				
							5.5		28	
Skovorodino-Arkhara	Skovorodino		20	2	1	17	17	56 3/		
							5.5		28	
		Taldan	[illegible]	0	[illegible]	[illegible]				
							5.5		32	

Table 4 (Continued)

TRANS-SIBERIAN RAILROAD

Estimated Capability based on Freight Steam Locomotive Repair Facilities

or	Type of Facility: Locomotive Depot	Type of Facility: Locomotive Turnaround Point	Total Number of Locomotive Repair Stalls	Stalls Deducted For: Branch Lines	Stalls Deducted For: Switch Loco's	Stalls Available for Main Line Loco's	Stalls Allotted for Turnaround Section or Division	Main Line Loco's Which Allotted Stalls Could Support per 24 hrs	TEWPD Which Could be Supported by These Locomotives: Single-headed	TEWPD for Sector Wh[...] Could be Supported [...] Limiting Sheds: Single-headed
	Magdagachi		24	0	1	23	23	65 3/		
							4		32	
		Ushumun	10	1	1	8				
							4		27	
	Shimanovskaya		24	0	1	23	23	54 3/		27
							0		27	
		Svobodny	0	0	0	0				
							0		29	
	Kuybyshevka-Vostochnaya		10	2	3	5	5			
									29	
		Zavitaya	18	1	1	16	16	58 3/		
									29	
		Bureya	6	0	1	5	5			
							3		29	
abarovsk		Arkhara	6	0	0	6				
							3		29	
	Obluche		24	1	1	22	22	57 3/		
							3.5		29	
		Bira	8	1	0	7				29
							3.5		30	
	In(Smidovich)	In(Smidovich)	24	4	1	19	19	61 3/		
							8		30	
-Vladivostok	Khabarovsk	Khabarovsk	30	6	8	16				
							8			
							4	41	41	
		Vyazemskaya	10	1	1	8				
							4		33	
	Bikin		12	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		33
							4.5		33	

Table 4 (Continued)

TRANS-SIBERIAN RAILROAD

Estimated Capability based on Freight Steam Locomotive Repair Facilities

Sector	Type of Facility: Locomotive Depot	Type of Facility: Locomotive Turnaround Point	Total Number of Locomotive Repair Stalls	Stalls Deducted For: Branch Lines	Stalls Deducted For: Switch Loco's	Stalls Available for Main Line Loco's	Stalls Allotted for Turnaround Section or Division	Main Line Loco's Which Allotted Stalls Could Support per 24 hrs	TEWPD Which Could be Supported by These Locomotives: Single-headed	TEWPD for Sector Which Could be Supported by Limiting Sheds: Single-headed
		Guberovo	10	0	1	9	4.5		41	
	Ruzhino		18	0	1	17	17	82		
		Yevgenyevka	6	0	1	5	2.5		41	
	Voroshilov		19	4	2	13	2.5 6.5	31	31	
	Pervaya Rechka		10	8	6	8	6.5 8	49	49	
	Vladivostok		12							

25X1

S-E-C-R-E-T

Table 5

TRANS-SIBERIAN RAILROAD

Sector Capability for Freight Trains 1/

Sector	Length (Miles)	Locomotive Repair Capability EWPD	Yard Capability TEWPD	Total Sector Capability	Capability in Freight Trains EWPD: Total, Single-headed 2/	Total, Double-headed 2/	After Deduction for Railroad Freight 3/: Single-headed	After Deduction for Railroad Freight 3/: Double-headed
Omsk-Novosibirsk	390	45 4/	45	45 5/ 45 4/	45 5/ 45 4/	0 0	43 5/ 43 4/	0 0
Novosibirsk-Achinsk	360	34	42	34	34	0	32	0
Achinsk-Tayshet	374	38	48	38	38	0	36	0
Tayshet-Irkutsk	416	45	33	33	21	12	19	12
Irkutsk-Slyudyanka	79	41 4/	33	33	23 6/	10 6/	21 6/	10 6/
Slyudyanka-Zaudinskiy	211	41	33	33	25	8	23	8
Zaudinskiy-Tarskiy	414	39	36	36	33	3	31	3
Tarskiy-Skovorodino	615	28	33	28	28	0	26	0
Skovorodino-Arkhara	482	27	36	27	27	0	25	0
Arkhara-Khabarovsk	274	29	25	21	13	18	11	18
Khabarovsk-Vladivostok	478	31	33	31	31	10	29	0

1/ Based on the limiting facility (locomotive repair or yard), within the limiting division.
2/ Based on optimum use of locomotives.
3/ Deduction made of two single-headed trains for railroad operation and maintenance.
4/ Based on steam locomotive operation.
5/ Based on electric operation, yard capability to handle only the single-headed heavier trains, and limited availability of electric locomotives.
6/ Capability of this electrified section assumed to be roughly equivalent to the tonnage capability immediately east of it.

S-E-C-R-E-T

S-E-C-R-E-T

Table 6

TRANS-SIBERIAN RAILROAD

Division Capability for Freight Trains

Sector	Division	Turnaround Point	Locomotive Repair Capability EWPD	Yard Capability TEWPD	Total Division Capability 1/	Capability in Freight Trains EWPD: Total 2/ Single-headed	Total 2/ Double-headed	After Deduction for Railroad Freight: Single-headed	After Deduction: Double-headed	After Deduction: Net tonnage EWPD
Omsk-Novosibirsk	Omsk									
			54 4/	45	45 5/ 45 4/	45 36	0 9	43 34	0 9	99,760 5/ 68,550 4/
		Tatarskaya								
			45	45	45 5/ 45 4/	45 45	0 0	43 43	0 0	99,760 5/ 58,695 4/
	Barabinsk									
			45	48	45 5/ 45 4/	45 45	0 0	43 43	0 0	99,760 5/ 58,695 4/
		Chulymskaya								
			53	48	48 5/ 48 4/	48 43	0 5	46 41	0 5	106,720 5/ 68,265 4/
Novosibirsk-Achinsk	Novosibirsk									
			49	35	35	21	14	19	14	54,780
		Bolotnaya								
			43	31	31	19	12	17	12	47,840
	Tayga									
			39	36	36	33	3	32	3	45,130
		Mariinsk								
			34	42	34	34	0	32	0	39,680
	Bogotol									
			34	42	34	34	0	32	0	39,680
Achinsk-Tayshet		Chernorechenskaya								
			38	48	38	38	0	36	0	40,500
	Krasnoyarsk									
			38	48	38	38	0	36	0	40,500
		Klyukvennaya								
			54	39	39	24	15	22	15	55,200
	Ilanskaya									
			54	39	39	25	15	22	15	55,200
Tayshet-Irkutsk		Tayshet								
			45	39	39	33	6	31	6	42,015

S-E-C-R-E-T

S-E-C-R-E-T

Table 6 (Continued)

Sector	Division	Turnaround Point	Locomotive Repair Capability EWPD	Yard Capability TEWPD	Total Division Capability 1/	Capability in Freight Trains EWPD: Total 2/ Single-headed	Total 2/ Double-headed	After Deduction for Railroad Freigh[t]: Single-headed	Double-headed	Net tonnage EWPD
	Nizhneudinsk		45	33	33	21	12	19	12	40,815
		Tulun								
			58	33	33	8	25	6	25	51,280
	Zima									
			58	54	54	50	4	48	4	55,480
		Cheremkhovo								
			53	60	53	53	0	51	0	51,255
Irkutsk-Slyudyanka	Irkutsk									
			41 4/	33	33	23 7/	10 7/	21	10	41,000 7/
Slyudyanka-Zaudinskiy		Slyudyanka 6/								
			41	33	33	25	8	23	8	40,635
		Mysovaya 6/								
			41	45	41	41	0	39	0	42,315
Zaudinskiy-Tarskiy	Ulan Ude									
			39	36	36	33	3	31	3	36,215
		Petrovskiy Zavod								
			64	36	36	8	28	6	28	47,590
	Khilok									
			64	39	39	14	25	12	25	49,300
		Mogzon								
			65	39	39	14	25	12	25	49,300
	Chita									
			55	36	36	7	29	5	29	48,045
		Karymskaya								
			33	36	33	33	0	31	0	36,270
Tarskiy-Skovorodino	Shilka									
			33	36	33	33	0	31	0	36,270
		Kaganovicha								
			42	36	36	30	6	28	6	45,420
	Zilovo									
			42	48	42	42	0	40	0	46,800
		Ksenyevskaya								
			32	42	32	32	0	30	0	35,100
	Mogocha									
			32	33	32	32	0	30	0	35,100

S-E-C-R-E-T

S-E-C-R-E-T

Table 6 (Continued)

Sector	Division	Turnaround Point	Locomotive Repair Capability EWPD	Yard Capability TEWPD	Total Division Capability 1/	Capability in Freight Trains EWPD: Total 2/ Single-headed	Total 2/ Double-headed	After Deduction for Railroad Freight: Single-headed	Double-headed	Net tonnage EWPD
		Amazar	28	33	28	28	0	26	0	30,420
	Yerofey-Pavlovich		28	39	28	28	0	26	0	30,420
		Urusha	28	39	28	28	0	26	0	30,420
Skovorodino-Arkhara	Skovorodino		28	33	28	28	0	26	0	31,460
		Taldan	32	27	27	22	5	20	5	35,050
	Magdagachi		32	27	27	22	5	20	5	35,050
		Ushumun	27	36	27	27	0	25	0	30,250
	Shimanovskaya		27	36	27	27	0	25	0	30,250
		Svobodny	29	36	29	29	0	27	0	32,670
	Kuybshevka-Vostochnaya		29	30	29	29	0	27	0	32,670
Arkhara-Khabarovsk		Arkhara	29	30	29	29	0	27	0	33,750
	Obluche		29	21	21	13	8	11	8	31,750
		Bira 6/	30	21	21	12	9	10	9	32,752
		In (Smidovich) 6/	30	24	24	18	6	16	6	33,500
Khabarovsk-Vladivostok	Khabarovsk		[illegible]	24	24	17	17	5	17	36,405
		Vyazemskaya	33	24	24	15	9	13	9	29,885

S-E-C-R-E-T

S-E-C-R-E-T

Table 6 (Continued)

Sector	Division	Turnaround Point	Locomotive Repair Capability EWPD	Yard Capability TEWPD	Total Division Capability 1/	Capability in Freight Trains EWPD: Total 2/: Single-headed	Total 2/: Double-headed	After Deduction for Railroad Freight 3/: Single-headed	Double-headed	Net tonnage EWPD
	Bikin									
		Guberovo	33	27	27	21	16	19	6	30,515
			41	24	24	7	17	5	17	36,405
	Ruzhino									
		Yevgenyevka	41	24	24	7	17	5	17	36,405
			31	33	31	31	0	29	0	29,725
	Voroshilov									
			49	30	30	11	19	9	19	44,185
	Vladivostok									

1/ Based on limiting facility (locomotive repair or yard).

2/ Based on optimum use of locomotives.

3/ Deduction made of two single-headed trains for railroad operation and maintenance.

4/ Based on steam locomotive operation.

5/ Based on electric operation, yard capability to handle only the single-headed heavier trains, and limited availability of electric locomotives.

6/ The Slyudyanka-Mysovaya section of the Irkutsk Division and the Bira-In section of the Obluche Division are assumed to operate like an independent division.

7/ Capability of this electrified section assumed to be roughly equivalent to the tonnage capability immediately east of it.

S-E-C-R-E-T

B. Capability in Tons per Train

1. Maximum Gross Train Tonnage

Capability of the Trans-Siberian in terms of maximum train tonnage is based on the following assumptions: (1) That all trains will carry maximum tonnage. Maximum tonnage on each section is determined on the basis of locomotive types in use, and the maximum grade. (2) That wherever necessary trains will be double-headed; that in sections with maximum grades trains will be run double-headed and with pusher, if necessary. (3) That locomotives used will be of the same types as those now known to be in use, as indicated in Table 1. (4) That yards and sidings are capable of holding either single-headed or double-headed trains; i.e., yard track lengths do not limit train tonnage except under electrified operation on the Omsk-Novosibirsk sector, where only single-headed trains can be handled.

Table 7 shows the maximum gross freight train tonnage capability on each sector of the Trans-Siberian railroad, based on the ruling grade and the representative locomotive type in use on the sector. These tonnages are given for the period April through October, during which full train tonnage can be carried, and November through March, during which train tonnage must be reduced due to low temperatures. The final section of the table shows yearly average tonnage. Tonnage reductions for the period November through March were calculated on the basis of the mean daily minimum temperature for a single town within each sector, using the reduction factors shown in the footnote.

2. Maximum Net Train Tonnage

Table 8 shows the average maximum net freight train tonnage capability, derived from gross freight train tonnages shown in Table 7. The net train tonnages were calculated on the basis of a 65 percent weighted average ratio of net to gross freight train tonnage. Calculations were performed for sections where traffic was representative for several sections, or was unique to one section. In each case, the estimated percentage distribution of 1955 eastbound freight traffic by commodity (CIA Contribution to EIC-R9-S1, Trans-Siberian Railroad Traffic, 1955) was utilized as the basis for the calculation. The net tonnage per car, of each commodity type, taken from Table 20, was weighted on the basis of this percentage distribution. Similarly, the tare weight per car, taken from Table 19, was weighted on the basis of the percentage distribution of each commodity carried in each type of car. The ratio of weighted net tonnage to weighted gross car weight (tare plus net tonnage) ranged between 62.9 percent on the Omsk-Novosibirsk sector and 64.6 percent on the Irkutsk-Ulan Ude sector. An average ratio of net to gross of 65 percent was used for reducing gross to net train loads. It should be stressed that this ratio applies only when all cars in a train are loaded; empty cars in a train were not considered in this study.

Table 7

TRANS-SIBERIAN RAILROAD

Maximum Gross Freight Train Tonnage Capability by Sector and by Representative 1/ Freight Locomotive Type (Short Tons)

Sector	Ruling Grade Eastbound	Representative Locomotive Type 1/	Gross Train Tonnage-Apr through Oct			Gross Train Tonnage-Nov through Mar			Gross Train Tonnage-Yearly Average		
			Single-headed 2/	Double-headed 3/	Double-headed with pusher 4/	Single-headed 5/	Double-headed 3/	Double-headed with pusher 4/	Single-headed 6/	Double-headed 3/	Double-headed with pusher 4/
Omsk-Novosibirsk	0.8	VL-22m	3,755 7/	6,760	--	3,305	5,945	--	3,565	7,130	--
Novosibirsk-Achinsk	0.9	L	2,005	3,610	--	1,765	3,175	--	2,100 9/ 1,905	3,780 9/ 3,430	--
Achinsk-Tayshet	1.0	L	1,825	3,280	--	1,605	2,885	--	1,730	3,120	--
Tayshet-Irkutsk I	1.0	Yea	1,655	2,980	--	1,390	2,505	--	1,545	2,780	--
Irkutsk I-Slyudyanka	2.0 8/	VL-22m	1,635 7/	2,945	--	1,410	2,535	--	1,540	3,080	--
Slyudyanka-Zaudinskiy	0.9	Yea	1,820	3,280	--	1,460	2,630	--	1,670	3,005	--
Zaudinskiy-Tarskiy	1.74	Yea	955	1,720	2,485	765	1,375	1,990	875	1,575	2,275
Tarskiy-Skovorodino	0.8	Yea	2,020	3,640	--	1,575	2,835	--	1,800	3,240	--
Skovorodino-Arkhara	0.8	Yea	2,020	3,640	--	1,615	2,910	--	1,855	3,335	--
Arkhara-Khabarovsk I	0.8	Yea	2,020	3,640	--	1,780	3,200	--	1,920	3,455	--
Khabarovsk I-Vladivostok	1.0	Yea	1,655	2,980	--	1,455	2,625	--	1,575	2,830	--

1/ Representative locomotive used is that which is estimated to comprise a large percentage of freight locomotives operating in the particular sector, and, in the case of the L locomotive, to approximate the average tractive effort of the locomotives used.

2/ Based on formula: $\frac{\text{Tractive effort @ 10 M/hr}}{(20 \times \text{Ruling grade in \%}) + 4.2}$ − Weight of engine and tender in short tons.

Curve resistance not included in formula since grades are assumed to be compensated for curvature. The figure 4.2 represents rolling resistance of cars averaging 50 tons gross weight at 10 m.p.h.

Table 7 (Continued)

3/ Based on 180 percent of single-headed tonnage except for electric locomotive sectors which are based on 200 percent.

4/ Based on 260 percent of single-headed tonnage.

5/ Based on temperature reduction factors used by the Canadian Pacific RR, applied to the average of the mean daily minimum temperatures for the five or six months when this temperature is below 15° F. Temperatures used are those available for a single town within the sector.

Canadian Pacific RR Temperature Reduction Factors:

	percent
Above 15° F	0
15 to 10 above	5
9 to 5 above	7
4 to 1 above	9
Zero to 4 below	12
5 to 9 below	14
10 to 14 below	16
15 to 19 below	20
20 to 24 below	22
25 to 30 below	25
More than 30 below	30

25X6

9/ Based on L (steam) locomotive.

Table 8

Trans-Siberian Railroad

Maximum Net Freight Train Tonnage Capability

by Sector (In Short Tons)

Sector	Single-Headed	Double-Headed
Omsk-Novosibirsk	2320 1/ 1365 2/	4640 1/ 2460 2/
Novosibirsk-Achinsk	1240	2230
Achinsk-Tayshet	1125	2030
Tayshet-Irkutsk	1005	1810
Irkutsk-Slyudyanka	1000 1/	2000 1/
Slyudyanka-Zaudinskiy	1085	1960
Zaudinskiy-Tarskiy	1025 3/	1480 3/
Tarskiy-Skovorodino	1170	2110
Skovorodino-Arkhara	1210	2170
Arkhara-Khabarovsk I	1250	2250
Khabarovsk I-Vladivostok	1025	1840

1/ Based on the use of the VL-22m electric locomotive.

2/ Based on steam locomotive operation.

3/ Based on the use of a helper steam locomotive over the 1.74 percent grade.

II. Over-all Description of the Line and Area Served

A. Geographic Description of the Area Along the Line

1. Terrain

The diverse topography as well as the great length of the Trans-Siberian Railroad makes it advantageous to treat the terrain in five sections: (1) Omsk - Novosibirsk, (2) Novosibirsk - Krasnoyarsk, (3) Krasnoyarsk - Irkutsk, (4) Irkutsk - Skovorodino, and (5) Skovorodino - Vladivostok.

a. Omsk - Novosibirsk (390 miles)

The Trans-Siberian Railroad from Omsk to Novosibirsk traverses a predominantly marshy plain that slopes almost imperceptibly toward the north. The most prominent relief feature on this section, the bluff-like eastern banks of the principal rivers, the Irtysh and Ob, rise as high as 130 feet. Wide flood plains usually occupy the western side of these streams. Many shallow, saucer-like depressions of different sizes lie along this section of the railroad, and a great number of them are occupied by small ponds, bogs, or temporary pools of water. To avoid these and stretches of marshy ground between them, the railroad roadbed is in many places built on earth embankments.

b. Novosibirsk - Krasnoyarsk (475 miles)

Immediately east of Novosibirsk the Trans-Siberian Railroad trends northeastward to avoid the abrupt, shelf-like formations of the Kuznetskiy Ala-Tau Range; the line traverses the gently rolling northern foothills of this range to Krasnoyarsk. The route utilizes many low saddles and passes through the dominantly birch forests of this upland, which is much more densely forested than the Omsk-Novosibirsk section. Three principal streams, the Tom', Kiya, and Chulym, are crossed by major bridges. These rivers are in fairly deep and wide valleys that in some areas are as much as 500 feet below the elevation of the surrounding terrain, causing the railroad to meander to surmount these local changes in elevation. After crossing the Kemchug River, a tributary of the Chulym, the railroad descends through the foothills to Krasnoyarsk, situated on both banks of the broad flood plain of the Yenisey River.

c. Krasnoyarsk - Irkutsk (675 miles)

The railroad from Krasnoyarsk to Irkutsk crosses an area of hilly plateau blocks, low domes, basins, and deep river valleys. Most of the area is covered by a dense coniferous forest, dominantly pine, spruce, and birch. The railroad crosses one watershed after another with a considerable variation in its grade line; elevations reach 508 feet above sea level at Krasnoyarsk, 1,600 feet near Nizhneudinsk, 1,922 feet south of Zima, and 1,532 feet opposite Irkutsk. The larger rivers are the Kan, Uda, Iya, and Oka. Many small, turbulent mountain streams also drain the area. The railroad traverses the largely cultivated valley of the Angara for about 100 miles between Cheremkhovo and Irkutsk. Here, river terraces are as high as 150 feet near the water's edge, but on the broad and comparatively level surface of these terraces, grades are not difficult. Between Krasnoyarsk and Irkutsk permafrost becomes a factor in maintenance of the Trans-Siberian Railroad. Alternate freezing and thawing at the surface of these "islands" of permafrost causes distortion of alinement of the roadbed, soil creep, and caving and buckling of structures.

d. Irkutsk - Skovorodino (1319 miles)

Between Irkutsk and Ulan-Ude, steep mountain walls, broken in the southwest by the Angara Valley and in the southeast by the Selenga Valley, rise 3,000 to 7,000 feet above the level of Lake Baykal. Shelf-like terraces which cut into the mountains along the edge of the lake enter these valleys. The old main line along the lake has tunnels, galleries, bridges, and precipitous rock cuts. Recently, a bypass route to detour this section was completed between Irkutsk and Slyudyanka. This new line ascends the Irkut valley south of Irkutsk, and then crosses the Primorskiy range over steep grades and through two tunnels to reach Lake Baykal. The maximum grade on this sector which is 2.0% is the steepest grade to be found now on the railroad. After paralleling the southern shore of the lake, the railroad crosses the open and relatively well-drained southern edge of the Selenga Delta before gradually ascending the steep-walled Selenga Valley to Ulan-Ude. From Ulan-Ude to Chita the line crosses the Yablonovyy Mountains utilizing, for the most part, the grassy Khilok Valley, which is 2 to 10 miles wide. Grades up to 1.74% are encountered as the line rises from Ulan-Ude to the Khilok Valley and as it descends from this valley to Chita. East of Chita to Skovorodino the railroad negotiates a wild, sparsely populated mountainous area, utilizing mainly the valleys of the Ingoda, Shilka, Kuenga, Belyy Uryum, Chernyy Uryum, and Amazar Rivers. This is an area characterized by a system of more or less parallel mountain ridges rising more than 1,500 feet above adjacent valleys. Valley bottoms are mostly flat; small lakes, marshes, and small tributary streams are common. Vegetation consists predominantly of coniferous forests with dense, scrubby undergrowth. The railroad structures in this area include a few tunnels and many cuts and bridges. Patches of permafrost cause damage to structures and rail alinement during the thaw periods.

e. Skovorodino - Vladivostok (1,234 miles)

From Skovorodino for a distance of approximately 200 miles southeastward to the Zeya River, the Trans-Siberian Railroad traverses a series of low pine, birch, and larch-covered plateau-like blocks between 30 and 60 miles northeast of the marshy floodplain of the upper Amur River. Southeastward from the Zeya River to the foothills of the Bureinskiy Mountains the railroad crosses a lowland characterized by well defined broad river terraces, interrupted by the Bureya River and the many other small tributaries of the Amur River. The railroad traverses a low pass through the Bureinskiy Mountains and then trends eastward over the level to gently rolling lowland of the middle Amur Valley into Khabarovsk.

At Khabarovsk the Trans-Siberian Railroad crosses the Amur River. It then turns southward and traverses the Ussuri Valley to the vicinity of Lake Khanka. Paralleling the swampy flood plain of the Ussuri River is a 1 to 20-mile wide terrace which provides an open route utilized by the railroad. This terrace is well drained by small, rapid flowing tributaries of the Ussuri River. Southward from the Ussuri Valley the railroad traverses the lowlands bordering Lake Khanka and its north-flowing tributary, the Lefu River. It then crosses to the lowland of the south-flowing Suyfun River along which swamps and marsh predominate. About 20 miles north of Vladivostok the railroad curves eastward and then southward along the coastal plain and across a spur of the Sikhote-Alin' Range to Vladivostok.

2. Climate

As shown in the following table, the Trans-Siberian area is characterized by cold winters, with average temperatures generally below zero in January, and cool summers, with July temperatures averaging between 63°F and 69°F. Precipitation along the entire line is low, ranging between 12 and 16 inches annually except on the Khabarovsk-Vladivostok sector where the total lies between 20 and 24 inches. Snowfall is deepest on the Omsk-Novosibirsk sector, ranging between 10 and 18 inches in December and January and decreases eastward, with 3 to 9 inches between December and March in sections east of Omsk. However, railroad tracks are seldom blocked by snow as snow plows are stationed along the line, and many sectors are protected by snow fences and shelter belts of trees. As indicated in the following table, the climate along the Omsk-Novosibirsk section is similar to that in Manitoba, Canada. Novosibirsk has 95 days a year with fog, coming particularly in autumn; Vladivostok has 85 days, particularly in summer. On most of the remaining sections of the line there are fewer days with fog.

Climatic Data for Sectors of the Trans-Siberian Railroad:

Sector	Mean Monthly Temperatures, °F January	July	Average Annual Precipitation(inches)	Deepest Snows Period	Depth, Inches
Omsk-Novosibirsk	-5 to 0	66	12-15	Dec-Jan	10-18
Novosibirsk-Krasnoyarsk	-1	67	12	Dec-Feb	5-7
Krasnoyarsk-Irkutsk	-8	63	14	Dec-Mar	5-9
Irkutsk-Skovorodino	-17	66	13	Jan-Feb	3
Skovorodino-Vladivostok	-19 to 7	64-69	16-24	Jan-Mar	3-6
Comparative data for Winnipeg, Canada	-4	66	20	Nov-Apr	4-9

3. Cultural Description

a. Major Cities Served

Most of the largest cities of the region served by the Trans-Siberian Railroad are situated at transshipment points where the railroad crosses or meets navigable waterways, the area's only other medium for large-scale transport. Within this category are Omsk (505,000 population in 1956) on the Irtysh River, Novosibirsk (731,000) on the Ob', Krasnoyarsk (328,000) on the Yenisey, Irkutsh (314,000) on the Angara near Lake Baykal, Ulan-Ude (158,000) on the Selenga, Khabarovsk (230,000) on the Amur, and Vladivostok (265,000) on the Sea of Japan. During the past 25 years each of these cities has been greatly expanded by the establishment of heavy manufacturing plants, except for Vladivostok where the growth has been caused by naval and military activities.

Short branch lines link the Trans-Siberian Railroad with Tomsk (224,000) on the Tom River, and to Blagoveshchensk (under 100,000) on the upper Amur; a longer branch line extends to Komsomol'sk (169,000) on the lower Amur and Sovetskaya Gavan' on the Gulf of Tatary.

Several large towns along the route are located in coal mining areas. Among these are Kansk (66,000), Cheremkhovo (124,000), Bukachacha (66,000), Artem (85,000) and Suchan (75,000). Short branch lines extend to the Kuznets, Chernogorsk, and Raychikhinsk coal basins. In the Kuznets basin, major cities are Stalinsk (347,000), Kemerovo (24,000), and Leninsk-Kuznets (119,000).

Smaller urban areas adjoining the railroad are engaged chiefly in lumbering and food production.

b. Freight Traffic Producers Along the Line

The exploitation of mineral and lumber resources and a young but growing manufacturing industry are the most important aspects of the economy along the Trans-Siberian Railroad, and are the major producers of freight traffic. Industry is concentrated in the larger cities, many of which are also administrative, transportation, and economic centers of regional importance. Coal mining is the most important extractive industry and supplies the fuel requirements of nearby railroads and local industry, and also sends large amounts to distant industrial areas. A second major natural resource is lumber, which is shipped primarily to markets in other parts of the U.S.S.R. and therefore receives long hauls. Agriculture production along the Trans-Siberian Railroad is keyed mainly to local consumption entailing relatively short rail hauls.

(1) Omsk - Novosibirsk

Aside from major industrial developments at Omsk and Novosibirsk, the economy along this segment of the railroad is primarily agricultural, with emphasis on dairying and wheat production which provide the basis for flour milling and meat packing industries in agricultural settlements along the railroad, notably Tatarsk, Barabinsk, Kuybyshev, Kargat, and Chulum. Grain is also shipped to these and other processing centers along the Trans-Siberian Railroad from the Kulunda Steppes to the south. Novosibirsk receives grain from the Turk-Sib Railroad and Tatarsk from the Kulunda branch line.

Both Omsk and Novosibirsk also receive agricultural products from the south and timber from the north by river. Although some agricultural products continue downstream into the Arctic region, grain and lumber comprise the bulk of the transshipments from river to rail at Omsk and Novosibirsk, and petroleum products and coal are the principal commodities transshipped from rail to river.

The location of Omsk and Novosibirsk between two major industrial complexes, the Urals and Kuznets Basin (discussed below), has contributed significantly to their industrial growth. Coal from the Kuznets; pig iron, steel, nonferrous metal ores, and aluminum from the Kuznets and Urals; and petroleum products from fields in the Ufa area and probably from Baku support metallurgy and metal working industries that manufactures finished products such as agricultural equipment, machine tools, and coal-mining machinery. The surrounding agricultural areas and the Kuznets Basin provide markets for these goods. Important airframe and aircraft engine plants as well as rubber, textile, and lumber industries are also located within both urban areas. Recent hydroelectric development at Novosibirsk has probably provided additional impetus to industrial expansion.

(2) Novosibirsk - Krasnoyarsk

Along the Trans-Siberian Railroad between Novosibirsk and Krasnoyarsk, mining and industry are of primary economic importance. Mining is concentrated chiefly in the Kuznets Basin, which is served by branches leading south from the Trans-Siberian, and also by the Trans-Siberian itself in the Anzhero - Sudzhensk area. There is also mining on a smaller scale in the upper Yenisey, Kiya, and Chulym Valleys. The extensive coal and iron ore deposits of the Kuznets Basin have made this area one of the leading industrial complexes of the U.S.S.R. In addition to supplying coke-chemical and metallurgical industries at Kemerovo, Stalinsk, and Gur'yevsk, coal is shipped to all parts of Western Siberia by rail. Other major exports from the Kuznets Basin to industrial centers along the Trans-Siberian are nonferrous metals, pig iron, and steel, along with some manufactured goods. Exploitation of local iron ore is increasing and appears to be satisfying most of the industrial requirements of the Kuznets Basin. Nevertheless significant quantities of iron ore and petroleum products are still imported by rail from the Urals.

The Chernogorsk coal mines in the upper Yenisey Valley supply fuel for Krasnoyarsk industries. These mines are tapped by a branch line which joins the Trans-Siberian Railroad at Achinsk. Southwest of Achinsk manganese ore is produced at the Mazulskiy mines. Commodities consumed along this branch include petroleum products and agricultural and industrial machinery.

Agriculture along this section of the railroad is focused largely on production of vegetables, dairy commodities, and grain for local consumption. Truck gardening and dairying are concentrated chiefly in the vicinity of the large urban centers, particularly in the densely populated Kuznets Basin. Elsewhere, in lowlands grain is the chief crop; in hilly areas emphasis is mainly on livestock. Flour milling, meat packing, and dairying are the principal industries in Mariinsk, Bogotol, and Achinsk.

Lumbering is of some importance in the area between Novosibirsk and Krasnoyarsk, but it is of major significance along principal rivers to the north and in the neighborhood of Tomsk. Wood and wood-chemical industries are important in both Tomsk and Krasnoyarsk.

Krasnoyarsk, located on the Yenisey, is a center of heavy metallurgy and machine construction. Its industrial capacity, combined with excellent rail and water transportation, makes Krasnoyarsk a major supply and distribution center for eastern Siberia.

(3) Krasnoyarsk - Irkutsk

The economy of the area along the Krasnoyarsk-Irkutsk section of the railroad is based mainly on lumber and coal-mining industries. The dense stands of timber in the Eastern Sayans support the numerous lumber, wood-working, and match plants found in most of the principal settlements along the railroad; lumber and mine timber are also produced for local coal-mining centers along the line. Chief centers of timber industries are Kansk, Tayshet, Nizhneudinsk, Tulun, Zima, and Usol'ye Sibirskoye. Usol'ye Sibirskoye is also the site of important chemical and salt installations.

Coal-mining is concentrated chiefly in the Cheremkhovo area within the Irkutsk Basin and to a lesser extent in the Kansk Basin. The Irkutsk Basin, which extends for approximately 300 miles along the Trans-Siberian Railroad from Nizhneudinsk southward to Lake Baykal, ranks as one of the largest coal-producing regions in the Soviet Union. In addition to meeting fuel requirements of the railroad, which is a major coal consumer, the Irkutsk Basin supplies important industries and thermoelectric powerplants in Cheremkhovo, Usol'ye Sibirskoye, and Irkutsk. Coal is also exported by railroad and river throughout central and eastern Siberia.

The abundant coal resources and hydroelectric developments along the Angara River, combined with excellent transportation for imported raw materials, have contributed significantly to the growth of industry in the area extending from Irkutsk to Cheremkhovo. The Cheremkhovo-Makar'yevo complex, using local coal and lead and steel imported by rail, includes the U.S.S.R.'s second largest submarine-battery plant, as well as plants manufacturing synthetic fuels and mining machinery. Principal industries in Irkutsk are an airframe plant and a heavy-equipment plant that produces metallurgical equipment, mining and excavating machinery, electrical components, and a variety of consumer goods. Numerous assembly and processing installations, based on local and imported raw materials, are also located in Irkutsk. Its role as a center of military industries and transportation makes the city a major supply depot for military operations in eastern Siberia and the Far East.

Agriculture is relatively unimportant along this section of the line and is limited chiefly to river valleys, notably the Angara Valley and the area between Krasnoyarsk and Kansk. These areas specialize in vegetable, grain, and dairy farming; livestock for meat and wool is raised chiefly in the forested hilly areas.

(4) Irkutsk - Skovorodino

East of Irkutsk, mining occupies a dominant position in the economy. Coal, iron ore, and nonferrous and rare metals are mined in many places throughout the mountainous Transbaykal region. The principal coal mines are located at Chernovskiye Kopi immediately west of Chita and at Bukachacha to the east. Minor deposits along the line are also worked. Coal of coking quality, however, is mined only at Bukachacha. Local coal, supplemented by coal shipped in by rail from Cheremkhovo, supply the fuel requirements of the industries and railroad operations concentrated at Ulan-Ude, Petrovsk - Zabaykal'skiy, and Chita.

Nonferrous metals are mined in the region, especially between the Shilka and Argun Valleys. The Tarskiy - Otpor branch serves a number of these mining areas.

The industry of the two largest cities -- Ulan-Ude and Chita -- is focused chiefly on serving railroad operations. Ulan-Ude has the largest railroad-equipment plant east of the Urals. Although concerned principally with rebuilding locomotives, some freight cars and parts are manufactured. An aircraft assembly plant and chemical, textile, and food-processing plants are among the other industries of Ulan-Ude. The largest installation in Chita is the railroad-equipment plant; in eastern Siberia, it ranks second only to the Ulan-Ude plant. Rail traffic that terminates here comes principally from the west and includes coke, iron, and steel from Petrovsk - Zabaykal'skiy and electrical equipment from Moscow as well as petroleum products, railroad and mining equipment, agricultural machinery, foodstuffs, and military material from industrial centers along the line. As the headquarters of the Transbaykal Military District, Chita has extensive storage depots to serve military requirements, as well as civilian storage facilities. Chemical, leather and various repair and machine construction plants are among the other enterprises within the city.

Since the region between Irkutsk and Skovorodino is predominantly mountainous, livestock raising -- with emphasis on meat, wool, and dairy products -- is the main agricultural activity; but spring wheat and oats are grown in the valleys. Together, these products support food-processing and leather industries in a number of settlements along the railroad and in the adjacent valleys.

(5) Skovorodino - Vladivostok

The area along the Trans-Siberian Railroad between Skovorodino and Vladivostok has undergone considerable industrialization in recent years based on exploitation of mineral resources. Lumber, non-ferrous ores and metals, furs, and fish are the major products exported from this area by rail.

Coal, the most important energy resource, is mined at Raychikhinsk, in the upper Bureya Valley at Urgal, and at Artem and Suchan. All are on branches of the Trans-Siberian Railroad. Brown coal (lignite) from the recently exploited deposits at Raychikhinsk and hard coal from the Bureya fields are used principally in the operation of railroads and in the production of electric power. Some is shipped east to power stations and industries at Khabarovsk and Komsomol'sk. Coal from the Artem and Suchan mines supports similar operations in nearby port cities of Vladivostok and Nakhodka. Suchan coal is also used as fuel for ships.

Khabarovsk is an important center for the assembly of aircraft and the manufacture of armaments. One of two large oil refineries in the Soviet Far East is located here. Petroleum and additional coal are shipped from Sakhalin to supply industries of Khabarovsk and Komsomol'sk. Komsomol'sk, on the Sovetskaya Gavan branch of the Trans-Siberian, has the Amurstal' steel mills, the only plant of its type in the Soviet Far East. The Ussuri Valley south of Khabarovsk is a major lumber-producing region. Most of the principal settlements have factories for processing timber, which is cut in the heavily forested Sikhote-Alin' Mountains. Birobidzhan, west of Khabarovsk, is also a major center of lumber and wood-processing industries.

Vladivostok, U.S.S.R.'s largest port and naval base on the Pacific, is the focus of maritime trade, shipbuilding, and fishing. Coal-mining, lumbering, and agriculture in the adjacent areas support other industries. The nearby settlement of Nakhodka is becoming increasingly important as a supplementary naval base and commercial port.

Agriculture along this easternmost stretch of the Trans-Siberian Railroad is confined chiefly to three areas: the Zeya-Bureya Plateau, the middle Amur Valley, and the Ussuri-Lake Khanka Lowland. In the northern areas, spring wheat and livestock raising predominate. The largest flour mill in the Soviet Far East is located at Blagoveshchensk. Svobodnyy and Kuybyshevka-Vostochnaya are also surrounded by farming land and are centers for the manufacture of agricultural and industrial equipment. In the Ussuri-Lake Khanka Lowland the chief crops are rice, soya beans, sugar beets, and grain. Voroshilov is an important agricultural center of this area.

c. Transportation route patterns

(1) Railroads

The Trans-Siberian Railroad is the only east - west transportation route across Asia capable of handling heavy traffic. Alternate rail routes exist or are under construction for some portions, but there is no complete alternate route. The railroad and the Northern Sea Route are the sole links between the great northward-flowing rivers, which are the region's only other means of large scale transport. The most significant roads in the region are those from the railroad to navigable waterways which the railroad does not reach, particularly the road from Never on the Trans-Siberian north to Yakutsk on the Lena River.

Omsk and Novosibirsk are the most important junctions on the railroad and the line between them is one of the most heavily traveled in the Soviet Union. Omsk is the junction of railroad lines from the Urals and European U.S.S.R. via Sverdlovsk and Chelyabinsk. East of Omsk, a line reaches southward from Tatarsk into the Kulunda grain producing area. At Novosibirsk, the Trans-Siberian is joined by the Turkestan-Siberian Railroad leading south and southwestward into Soviet Central Asia, and by the main rail outlet of the heavily industrialized, coal-producing Kuzbass to the Southeast. East of Novosibirsk, branches lead into the Kuzbass from Yurga and Anzhero-Sudzhensk. The South Siberian Railroad extends westward from the Kuzbass, and offers an alternate route for the Trans-Siberian. Between the Kuzbass and Irkutsk there is no alternate railroad.

A short branch line reaches northward from Tayga through Tomsk on the Tom River to Asino on Chulym River. A longer branch extends southward from Achinsk to the Chernogorsk coal fields and the Abakan agricultural area.

The BAM (Baykal-Amur Magistral) extends eastward from Tayshet to Ust Kut and Osetrovo on the Lena River.

Between Irkutsk and Slyudyanka traffic now moves on a recently completed electrified double-tracked line following the Irkut valley. Part of the old main line has been flooded by the Angara river dam. The flooded section may be replaced by a new track to be built on the north bank of the Angara River from Irkutsk to Lake Baykal. From Ulan-Ude a branch line runs south and southeastward through Mongolia to China. The southern portion of this line (Ulan Bator-Chining) was opened to traffic in 1956. This line, the Trans-Mongolian, is the shortest rail route between the most populous areas of the U.S.S.R. and China, and it will carry a significant share of the traffic between the two nations. Another line to China branches southeastward from Tarskiy and connects with the Manchouli-Harbin-Suifenho line in Manchuria. A line into eastern Mongolia joins this branch at Borzya.

From Kuenga, a short branch goes eastward to Sretensk, head of navigation on the Shilka River (a tributary of the Amur), and terminus of a road leading southward to Borzya. At Kaganovicha branches lead to Olov and the Bukachacha coal fields. From the Skovorodino area a short line branched northward to Tynda until World War II when it was apparently dismantled. This branch is to be restored and extended northward to a coal field at Chulman. The branch roughly parallels a road from Never to Yakutsk which is the main supply route for settlements along the Lena River and its tributaries in winter, when freezing halts navigation.

From Skovorodino eastward to Birobidzhan there are several short branches to the south which connect the railroad with ports on the Amur River at Dzhalinda, Blagoveshchensk, Poyarkovo, Pashkovo, and Nizhne Leninskoye. Two short branch lines link Bureya with nearby coal fields around Raychikhinsk.

From Izvestkovaya a branch extends northward to Urgal and thence eastward to Komsomol'sk where it joins a branch from Volochayevka which leads eastward to Sovetskaya Gavan'.

Between Khabarovsk to Manzovka there is only a single branch line extending eastward to a lumbering area east of Obor. At Manzovka branches northwest to Turiy Rog and east to Varfolomeyevka serve airfields and military installations.

From Voroshilov a branch extends westward to connect with the Manchouli-Harbin-Suifenho line, forming a continuation eastward from Tarskiy. From Baranovskiy a branch extends southward into Korea.

At Ugol'naya, a short distance north of Vladivostok, a branch goes eastward to the Suchan coal mining area from where it leads south to Nakhodka, a port of growing importance for commercial traffic diverted from Vladivostok, and north to Sergeyevka.

(2) Roads

Highways tributary to the Trans-Siberian Railroad are generally local in construction and function.

From Omsk to Chita and from Birobidzhan to Vladivostok the Trans-Siberian Railroad is paralleled by motorable roads, although few of them are paved all-weather routes capable of supporting high density truck traffic. Improved roads radiate from larger cities such as Omsk, Novosibirsk, Achinsk, Irkutsk, Ulan-Ude, Chita, Sretensk, and Svobodnyy. Roads running south from some of these cities lead to the border of Mongolia and China. From Irkutsk and Never improved all-weather roads connect with inland shipping on the Lena River at Ust'Kut and Yakutsk, respectively. The paved Stalin highway from Birobibzhan to Vladivostok was built primarily as a military supply route.

In the area north of Vladivostok roads primarily of military significance lead westward and southward from the Trans-Siberian, generally paralleling branch railroads, to the borders of Manchuria and Korea and eastward primarily to military installations.

(3) Waterways

Two river systems, the Ob and Yenisey, intersect the Trans-Siberian railroad approximately at right angles. Another system, the Lena, is connected with the Trans-Siberian by means of the Baykal-Amur Magistral (BAM) branch line from Tayshet to Osetrovo. The Amur river parallels the Trans-Siberian and has several navigable tributaries which cross the railroad at right angles. The Ob river system connects with the Trans-Siberian by means of the Irtysh at Omsk, the Ob proper at Novosibirsk, the Tom near Yurga, the Kiya at Mariinsk and the Chulym at Achinsk. The Yenisey river system connects with the railroad by means of the Yenisey proper at Krasnoyarsk; the Oka at Zima; the Angara at Irkutsk; and the Selenga at Ulan-Ude.

The Amur river system connects with the Trans-Siberian by means of the Shilka which parallels the railroad from Chita eastward to its confluence with the Amur south of Yerofey Pavlovich. The Amur proper parallels the railroad from its confluence with the Shilka to Khabarovsk and from thence acts as a tributary of the railroad to its mouth. At Svobodnyy the Zeya, and at

Kuybyshevka-Vostochnaya the Tom, a tributary of the Zeya, connect with the railroad. The Bureya connects at Raychikhinsk and the Bira at Birobidzhan. The Ussuri River and Lake Khanka parallel the railroad from Khabarovsk to Spassk-Dalniy.

(4) Pipelines

Currently only one oil pipeline is known to exist in the area east of Omsk. From the oil fields of Sakhalin a pipeline carries crude to the refinery at Komsomolsk.

The Sixth Five-Year Plan (1956-1960) provides for the completion of two pipelines between the Ufa area and Irkutsk, one for crude, the other for refined products. It is planned to later extend one of these lines eastward to the Khabarovsk area. Since the Trans-Siberian moves a large volume of petroleum traffic, these pipelines will relieve the Omsk-Irkutsk section of line of part of its traffic burden, both of eastbound loaded and westbound empty tank cars.

A gasoline pipeline is also being extended eastward from Omsk to Novosibirsk. In April 1956 the Tatarsk-Barabinsk section was being laid.

(5) Civil Air Lines

In the region served by the Trans-Siberian Railroad the network of Aeroflot, the Soviet civil air carrier, is built around an east-west route and several north-south routes. The route from Moscow to the Far East parallels the Trans-Siberian Railroad and has other main and secondary routes radiating from the following important cities on the railroad: Sverdlovsk, Omsk, Novosibirsk, Krasnoyarsk, Irkutsk, Chita, Magdagachi, and Khabarovsk. From Khabarovsk routes go south to Vladivostok and north to Sovetskaya Gavan and Magadan.

Recently Aeroflot has extended its service out of Magadan and has incorporated into the scheduled network certain Arctic and regional routes in Northeast Siberia.

Connections between Aeroflot routes and the Chinese Civil Air Fleet are provided at Irkutsk and Alma Ata and with North Korean Civil Air Fleet at Chita. These services are coordinated through the Sino-Soviet Bloc civil air network and the airlines are standardized on the same types of aircraft and operational procedures.

B. Technical Characteristics of the Line

1. Line Characteristics

The line characteristics of the various sectors of the Trans-Siberian railroad are shown in Table 9. The railroad is double tracked, except for the single track Amur river bridge at Khabarovsk and two short sections of triple track between Ulan-Ude and Chita. There is, however, a single track tunnel under the Amur river parallel to the bridge for use in emergencies. The line is electrified from Omsk to Novosibirsk and from Irkutsk to Slyudyanka via the new by-pass line. Westward from Irkutsk toward Tayshet further electrification is currently underway. The electrification of the remaining sections between Omsk and Slyudyanka is projected during the Sixth Five Year plan period (1956-60).

The track structure of the Trans-Siberian railroad is light by U. S. standards. It is estimated that the dominant rail weight on the Omsk-Achinsk sector is 101 pounds per yard on the main line, although there are probably some sections still having 86 pound rail. From Achinsk to Khabarovsk, 77 pound rail predominates. The weight of rail on the new Irkutsk-Slyudyanka by-pass and Khabarovsk-Uladivostok sectors is unknown, although heavier type rail is believed to have been installed on the former line. The standard Soviet rail is 41.25 feet long. Rail joint bars are 6 hole, 31.5 inches long. Rail joints are opposite (not staggered). Rail anchors are used, averaging between 7 and 10 per rail length.

Most ties now being laid on the Trans-Siberian are creosoted; the ties measure 7" x 10" x 9', and approximately 2800 ties are laid per mile, providing an average spacing of 22.5 inches between tie centers.

The track on this railroad is ballasted with crushed rock and broken stone from Omsk to Achinsk; crushed rock and sand from Achinsk to Irkutsk; possibly crushed rock on the Irkutsk-Slyudyanka by-pass; and primarily sand from Slyudyanka to Vladivostok.

Maximum permissible axle loads, calculated on the basis of the weight of rail and type of track, is estimated at 24 tons on the Omsk-Achinsk sector, which has primarily 101 pound rail, and 22 tons on the remainder of the line on

Table 9
TRANS-SIBERIAN RAILROAD
Line Characteristics

Sector	Sector Dist. Miles	Type of Traction Used	Loco. Types Used	Ruling Grade 1/ E.B.	Ruling Grade 1/ W.B.	Minimum Radius of Curvature 1/ Feet	Weight of Rail lbs/yd	Cond. of Rail	Max. Axle Load Short Tons	Ballast	Signals Max. Dist. Bet. Miles	Signals Type 2/	Max. Dist. Bet. Stations Miles	Maximum Distance Between Watering Facilities Miles
Omsk - Novosibirsk	390	Electric and Steam	VL-22m SO 17, SO 19 L, Yea Yel, E, Em, Eg 3/	0.8	0.8	1,738	101	Good	24	Crushed rock, broken stone	1.8	A.B.	19.3	33
Novosibirsk - Achinsk	360	Steam	L, Yea, SO-17, SO-19 FD, Eg Em, Er	0.9	0.9	1,046	101	Good	24	"	1.8	A.B.	10.6	24
Achinsk - Tayshet	374	Steam	L, Yea, SO, LV Eg, Em, Er	1.0	1.0	1,046	77	Good	22	Crushed rock and sand	na	Assumed S.A.B.	9.9	20
Tayshet - Irkutsk I	416	Steam	Yea, Yel, Em, LV	1.0	1.0	909	77	Good	22	"	na	Assumed S.A.B.	14.3	22

S-E-C-R-E-T

Table 9 (continued)
TRANS-SIBERIAN RAILROAD
Line Characteristics

Sector	Sector Dist. Miles	Type of Traction Used	Loco. Types Used	Ruling Grade 1/ E.B.	Ruling Grade 1/ W.B.	Minimum Radius of Curvature 1/ Feet	Weight of Rail	Cond. of Rail	Max. Axle Load Short Tons	Ballast	Signals Max. Dist. Bet. Miles	Signals Type 2/	Max. Dist. Bet. Stations Miles	Maximum Distance Between Watering Facilities Miles
Irkutsk I - Slyudyanka	79	Electric	VL-22m N-8	2.0 3/	2.0 3/	na	na	Good 4/	na	na	na	Prob. A. B.	12.0	na
Slyudyanka - Zaudinskiy	211	Steam	Yea, Yol, Em	0.9	0.9	1,050	77	Fair	22	Mostly sand or clay	na	St.S	10.6	26
Zaudinskiy - Tarskiy	414	Steam	Yea, Yol, Em	1.74	1.74	1,050	77	Fair	22	Mostly sand or clay	na	St.S	13.1	22
Tarskiy - Skovorodino	615	Steam	Yea, Yol Yem, Yes	0.8	0.9	1,050	77	Poor	22	"	na	St.S	14.9	30
Skovorodino - Arkhara	482	Steam	Yea, Yem Yes, E	0.8	0.8	1,050	77	Poor	22	"	na	St.S	13.1	28
Arkhara - Khabarovsk I	274	Steam	Yea, Yem Lv	0.8	0.8	1,050	77	Poor	22	"	na	St.S	10.6	25
Khabarovsk I - Vladivostok	478	Steam	Yea, Yem Lv	1.0	1.0	840	na	na	na	"	na	na	9.9	26
Total	4,093													

Note: Line is 5'0" gage, double track throughout except for two short triple track sections between Ulan Ude and Chita. Wooden creosated ties laid 2,800 per mile predominate.

S-E-C-R-E-T

25X1

2/ A. B., automatic block; S. A. B., semi-automatic block; St. S., Station signal (station to station block).

3/ Estimated, based on Soviet announcements.

4/ Estimated, based on relative time indicated in the 1956 timetable.

which 77 pound rail predominates. It has been assumed that bridges will support these axle loads. Axle loadings of freight locomotives known to be operating on the Trans-Siberian (Table 11) vary from a low of 17.1 tons (Yes) to a high of 22.7 tons (FD-21). Rail weights permit all these types to operate on the Omsk-Achinsk sector but prevent the operation of the FD-20 and FD-21 east of Achinsk at high speeds or for prolonged periods.

25X1

The maximum grade on the line is believed to be 2.0 percent on the new Irkutsk-Slyudyanka by-pass. The second heaviest grade, and formerly the heaviest, is 1.74 percent against eastbound traffic between Gorkhon and Kizha, east of Ulan-Ude; and 1.74 percent against westbound traffic between Yablonovaya and Turgutai, west of Chita. Elsewhere, maximum grades are limited to 1.0 percent.

Minimum radius of curvature is 1738 feet on the Omsk-Novosibirsk sector, and gradually decreases to 909 feet on the Tayshet-Irkutsk sector, is 1050 feet from Slyudyanka to Khabarovsk, and falls to 840 feet from Khabarovsk to Vladivostok.

The maximum distance between any two adjacent stations on the railroad is 19.3 miles, found on the Omsk-Novosibirsk sector. The maximum distance between watering facilities is 33 miles, also on the Omsk-Novosibirsk sector; however, this sector is now electrified.

2. Signals

The Trans-Siberian has automatic block signals from Omsk to Achinsk, spaced a maximum of 1.8 miles apart. From Achinsk to Irkutsk the signalling is assumed to be semi-automatic block but may be manual block with electric signals at the block stations (and perhaps a "distant" signal further out on each side of each block station). The former consists of an intermediate signal midway between the block stations which is controlled by the block station which the train is approaching.

The Irkutsk-Slyudyanka by-pass line is believed to have automatic block signalling, but the spacing is not known. From Slyudyanka to Vladivostok it is estimated that signals are found only at stations although it is possible that a higher type of signalling is in operation between Khabarovsk and Vladivostok.

3. Yards

Generally, yards on the Trans-Siberian railroad are small (details on yards are given in Table 3). Major classification yards are located at Omsk, Novosibirsk, Krasnoyarsk, Irkutsk, Ulan-Ude, Chita, Kuybyshevka-Vostochnaya, Khabarovsk, Voroshilov, and Pervaya Rechka (Vladivostok). The total number of tracks in these terminals range from 20 to 30 each, except for Novosibirsk which has an estimated 75, primarily in Inskaya. The remaining yards on the Trans-Siberian are used primarily for the relay of trains, which includes changing locomotives, inspection of cars, and removal of bad-order cars. These yards have between 6 and 20 tracks, the greater number of tracks generally occurring where there is some classification, as at Cheremkhovo, which assembles and disassembles coal trains for nearby coal mines. In general, the number of tracks in relay yards decreases from west to east.

25X1

4. Locomotive Repair Facilities

a. Locomotive Depots and Turnaround Points

The standard type of locomotive depot or turnaround point shed on the Trans-Siberian railroad is rectangular in shape. It is traversed by three tracks, with three doors on each end, permitting 6 main-line steam locomotives to occupy the shed simultaneously. A less common type of shed has two tracks and space for 4 locomotives. When a repair point has more than one shed, the buildings are generally placed in echelon. There are only a few locomotive roundhouses on this line.

Points which operate as locomotive depots (home terminals) usually have several sheds, and some of the sheds or stalls are utilized for medium repairs. However, the overall number of stalls in these depots is small. In addition, a number of cities have large repair factories which perform either medium or capital repairs, or both. At present, no locomotives are known to be manufactured in any city located on the Trans-Siberian railroad. Locomotive factories formerly used for this purpose are now apparently devoted to either medium or capital repairs, or both.

Locomotive turnaround points (where the locomotive is serviced and turned, and is given light repairs only when necessary) normally have only one or two sheds (see Table 10).

The distance between a locomotive depot and its adjacent turnaround points averages 77 miles varying from 50 to 110 miles, with the shorter distances found east of Tarskiy.

Available intelligence on locomotive repair facilities varies considerably on the number of stalls at each city. In addition, it disagrees on the number of buildings in a repair area, the number of buildings which are entered by railroad tracks, the number of tracks entering the building and the number of locomotives which can be accommodated on each track.

In the analysis of locomotive repair facilities, it has been assumed in every case that each track in locomotive sheds could accommodate no more than two locomotives. [redacted]

25X1
25X1

[redacted]

S-E-C-R-E-T

Table 10

TRANS-SIBERIAN RAILROAD

Steam Locomotive Repair Facilities

Location	Function	Distance from Moscow (miles)	Distance between Locomotive Facilities (miles)	Locomotive Repair Facilities: Running and Medium Repair: Estimated No of Sheds	Estim. No of Stalls per Shed	Estim. Total No of Stalls	Capital Repair
Omsk	D 1/	1,688	-	1 2	12 6		-
(Moskovka)	D	1,692	101	1	14	38	
Tatarskaya	T 2/	1,793	96	1	6	6	-
Barabinsk	D	1,889	106	2 1 3/	6 10 3/	22	-
Chulymskaya	T	1,995	82	2	4	8	-
Novosibirsk II (Inskaya)	D	2,077	78	1 1 3 3/	6 8 6 3/	32	x
Bolotnaya	T	2,155	65	1 1 4/	6 12 4/	18	-
Tayga	D	2,220	93	3	6	18	-
Mariinsk	T	2,313	82	2	6	12	-
Bogotol	D	2,395	68	1 1 3/	6 6 3/	12	-
Chernorechenskaya	T	2,463	89	1	6	6	-
Krasnoyarsk	D	2,552	81	4	6	24	x
Klyukvennaya	T	2,633	92	1	6	6	-
Ilanskaya	D	2,725	87	1 1 4/	6 20 4/	26	-
Tayshet	T	2,812	101	2	6	12	-
Nishneudinsk	D	2,913	73	3	6	18	-

S-E-C-R-E-T

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S-E-C-R-E-T

Table 10 (continued)

TRANS-SIBERIAN RAILROAD

Steam Locomotive Repair Facilities

Location	Function	Distance from Moscow (miles)	Distance between Locomotive Facilities (miles)	Locomotive Repair Facilities: Running and Medium Repair: Estimated No. of Sheds	Estim. No of Stalls per Shed	Estim. Total No of Stalls	Capital Repair
Tulun	T	2,986	86	2	6	12	-
Zima	D	3,072	74	4	6	24	-
Cheremkovo	T	3,146	76	1 2	6 4	14	
Irkutsk II	D	3,222	84	1 2	20 6	32	-
Slyudyanka	T, D	3,306	103	2	6	12	-
Mysovaya	T	3,409	102	2	6	12	-
Ulan Ude	D	3,511	69	3	6	18	x
Gorkhon	Helper	3,580	20	1 1	6 4	10	-
Petrovskiy Zavod	T	3,600	93	1 2	2 4	10	-
Khilok	D	3,693	75	4 1	6 4	28	-
Mogzon	T	3,768	40	2	6	12	-
Yablonovaya	Helper	3,808	47	1	6	6	-
Chita	D	3,855	63	6	6	36	x
Karymskaya	T	3,918	90	4	6	24	-
Shilka	D	4,008	91	3	6	18	-
Kaganovicha	T	4,099	52	3	6	18	-

S-E-C-R-E-T

Table 10 (continued)

TRANS-SIBERIAN RAILROAD

Steam Locomotive Repair Facilities

Location	Function	Distance from Moscow (miles)	Distance between Locomotive Facilities (miles)	Locomotive Repair Facilities: Running and Medium Repair: Estimated No of Sheds	Estim. No of Stalls per Shed	Estim. Total No of Stalls	Capital Repair
Zilovo	D	4,151		4 2	6 4	32	
			80				
Ksenyevskaya	T	4,231		1 1	6 4	10	-
			67				
Mogocha	D	4,298		1 4	6 4	22	-
			61				
Amazar	T	4,359		2	6	12	-
			66				
Yerofey Pavlovich	D	4,425		3 5/	6 5/	18	-
			62				
Urusha	T	4,487		2	6	12	-
			58				
Skovorodino	D	4,545		2 2	4 6	20	-
			60				
Taldan	T	4,605		2 5/	6 5/	12	-
			58				
Magdagachi	D	4,663		4 5/	6 5/	24	-
			67				
Ushumun	T	4,730		1 1	4 6	10	-
			75				
Shimanovskaya	D	4,805		4	6	24	-
			89				
Kuybyshevka Vostochnaya	D 6/	4,894		1 1	6 4	10	-
			74				
Zavitaya	T 6/	4,968		3 5/	6 5/	18	-
			28				
Bureya	T 6/	4,996		1	6	6	-
			32				
Arkhara	T	5,028		1	6	6	-
			70				
Obluchye	D	5,098		4	6	24	-
			69				

Table 10 (continued)

TRANS-SIBERIAN RAILROAD

Steam Locomotive Repair Facilities

Location	Function	Distance from Moscow (miles)	Distance between Locomotive Facilities (miles)	Locomotive Repair Facilities: Running and Medium Repair: Estimated No of Sheds	Estim. No of Stalls per Shed	Estim. Total No of Stalls	Capital Repair
Bira	T	5,167		2	4	8	-
			72				
In (Smidovich)	D	5,239		4	6	24	-
			68				
Khabarovsk II	T & D	5,307		5 5/	6 5/	30	-
			73				
Vyazemskaya	T	5,380		1 1	6 4	10	-
			65				
Bikin	D	5,445		2 5/	6 5/	12	-
			52				
Guberovo	T	5,497		1 1	6 4	10	-
			57				
Ruzhino	D	5,554		3	6	18	-
			73				
Yevgenyevka	T	5,627		1	6	6	-
			82				
Voroshilov	D	5,709		1 4/ 1	13 4/ 6	19	x
			68				
Pervaya Rechka	D	5,777		1 1 3/4/	4 6 3/4/	10	-
			3				
Vladivostok	D	5,780		2	6	12	-

25X1

1/ Locomotive depot (home terminal)
2/ Locomotive turnaround point

b. Locomotive Repair Plants

Following is the estimated number of locomotives which can be accommodated simultaneously in erection shops of locomotive repair plants, which perform medium and heavy repairs: Omsk, 7; Krasnoyarsk, 3; Novosibirsk, 3; Ulan-Ude, 7; Voroshilov, 4.

5. Coaling and Watering Facilities

There are insufficient data to permit an accurate determination of the type of coaling and/or watering facility at each point along the Trans-Siberian railroad. Watering facilities are spaced at an average distance of about 15 miles. Locomotive coaling facilities at many terminals appear to be equipped with cranes but at other points locomotive tenders are loaded by hand. At some points coaling towers are in use.

C. Equipment

1. Locomotives

a. Types in Use

The types of freight locomotives used on the various sectors of the Trans-Siberian are shown in Table 9. In general, the newer and heavier types of locomotives are used on the western sectors, although some heavier types have been seen near Khabarovsk. Some passenger trains are pulled by electric locomotives on the sections between Omsk and Novosibirsk, and by steam JS and SU locomotives from Novosibirsk to Achinsk. The SU passenger locomotive is used on all sections of the line which are not electrified. Some new P-36 passenger locomotives are now in operation on the Tayshet-Irkutsk section. The type O steam locomotive is used for switching on the entire line. Specifications and characteristics of steam freight locomotives used on the railroad are shown in Tables 11 through 15.

Following are specifications of electric locomotives used on the railroad:

Loco. Type	Wheel Arrangement	Year Built	Total Weight lbs. 1/	Hourly Rating, in h. p.
VL-22m	0-6-0 - 0-6-0	1947	291,060	3260
N-8	0-4-4 - 4-4-0	1954	396,900	5700

25X1

Table 11
TRANS-SIBERIAN RAILROAD
Specifications of Steam Freight Road Locomotives Used 1/

Loco. Type	Wheel Arr.	First Year Produced	Weight on Drivers (lbs)	Weight of Loco. in Working Order (lbs)	Weight of Tender (lbs)	Boiler Pressure lbs per sq. inch	Number of Cylinders	Cylinder Diameter (inches)	Piston Stroke (inches)	Diameter of Drivers (inches)	Percent of Cut-off 2/	Starting Tractive Force at Rim of Wheel 3/ (lbs)	Factor of Adhesion 4/
SO-17	2-10-0	1934	193,158	212,520	145,200	198.8	2	25.6	27.6	52	65	48,938	3.95
SO-19 5/	2-10-0	1934	207,270	228,046 6/	179,300	198.8	2	25.6	27.6	52	70	50,986	4.06
L 7/	2-10-0	1945	200,655	227,115	170,887	198.8	2	25.6	31.5	59.1	65	49,303	4.07
LV	2-10-2	1952	199,552	264,600	n. a.	198.8	2	25.6	31.5	59.1	65	49,303	4.04
Yea	2-10-0	1944	188,968	212,121	161,406	180.3	2	25	28	52	70	44,901	4.2
Yel	2-10-0	1917	177,061	202,198	152,586	180.3	2	25	28	52	65	43,081	4.1
Yes	2-10-0	1917	171,108	195,399 6/	147,455 6/	180.3	2	25	28	52	65	43,081	3.97
Yem	2-10-0	1944	188,968	212,121	161,406	180.3	2	25	28	52	70	44,901	4.2
E	0-10-0	1914	179,046	179,046	135,607	170.4	2	25.6	27.6	52	65	42,083	4.25
Em	0-10-0	1931	182,794	182,794	146,632	198.8	2	25.6	27.6	52	55 8/	44,257	4.13
Eg	0-10-0-	1932	179,046	179,046	135,607	170.4	2	25.6	27.6	52	65	42,083	4.25
Er	0-10-0	1932	184,117	184,117	146,632	198.8	2	25.6	27.6	52	55 9/	44,257	4.16
FD-20	2-10-2	1931	222,043	296,352	271,215	213	2	26.4	30.3	59.1	60	51,754	4.29
FD-21	2-10-2	1941	227,115	302,085	271,215	213	2	26.4	30.3	59.1	60	51,754	4.38

25X1

Table 12

Boiler Characteristics

Locomotive Type	Direct Heating Surface (sq. ft.)	Indirect Heating Surface (sq. ft.)	Length of Tubes (ft.)	Rate of Evaporation per sq. ft. Indirect Surface 1/ lbs per sq ft per hr	Rated Evaporation lbs per hour (max) 2/
SO-17	264.16	2207.09	15.29	10.78	38,321.23
SO-19	264.16	2207.09	15.29	10.78	38,321.23
L	277.61	2114.34	16.90	10.23	36,898.25
Yea	227.04	2239.16	16.66	10.30	35,550.55
Yel	227.04	2382.26	16.91	10.23	37,857.72
Yes	227.04	2382.26	16.87	10.24	36,881.54
Yem	227.04	2239.16	16.66	10.23	35,393.81
E	194.76	2033.64	15.29	10.78	32,634.44
Em	194.76	1930.34	15.29	10.78	31,520.87
Eg	194.76	2033.64	15.29	10.78	32,634.44
Er	245.33	1887.30	15.29	10.78	33,838.24
FD-20	336.03	2828.37	19.59	9.32	44,842.06
FD-21	333.56	2205.80	19.59	9.32	38,903.86

1/ Factor based on length of tubes.
2/ Based on the formula:

Rated evaporation (lbs per hour) = (DHS x 55) + (IHS x ISRE).

DHS = Direct heating surface (sq ft).
55 = Constant valve of evaporation per square foot of direct heating surface for boilers of low capacity.
IHS = Indirect heating surface.
ISRE = Indirect heating surface rate of evaporation - a factor based on length of tubes.

S-E-C-R-E-T

Table 13

Boiler Tractive Force 1/
(pounds)

Column No.: 1	2	3	4	5	6	Boiler Tractive Force SPEED				
Locomotive Type	Rated Evaporation Lbs. per hour	Steam Pressure psi	Lbs. steam per Ind. H.P. hour	Boiler H.P. Col. 2 ÷ 4	Col. 5 x 375	10 mph	15 mph	20 mph	25 mph	30 mph
SO-17	38,321.23	198.80	19.7	1,945.24	729,465	72,946.5	48,631.0	36,473.3	29,178.6	24,315.5
SO-19	38,321.23	198.80	19.7	1,945.24	729,465	72,946.5	48,631.0	36,473.3	29,178.6	24,315.5
L	36,898.25	198.80	19.7	1,873.00	702,375	70,237.5	46,825.0	35,118.8	28,095.0	23,412.5
Yea	35,550.55	180.30	20.25	1,755.58	658,343	65,834.3	43,889.5	32,917.2	26,333.7	21,944.8
Yel	37,857.72	180.30	20.25	1,869.51	701,066	70,106.6	46,737.7	35,053.3	28,042.6	23,368.9
Yes	36,881.54	180.30	20.25	1,821.31	682,991	68,299.1	45,532.7	34,149.6	27,319.6	22,766.4
Yem	35,393.81	180.30	20.25	1,747.84	655,440	65,544.0	43,696.0	32,772.0	26,217.6	21,848.0
E	32,634.44	170.4	20.55	1,588.05	595,519	59,551.9	39,701.3	29,776.0	23,820.8	19,850.6
Em	31,520.87	198.80	19.7	1,600.04	600,015	60,001.5	40,007.0	30,000.8	24,000.6	20,000.5
Eg	32,634.44	170.40	20.55	1,588.05	595,519	59,551.9	39,701.3	29,776.0	23,820.8	19,850.6
Er	33,838.24	198.80	19.7	1,717.67	644,126	64,412.6	42,941.7	32,206.3	25,765.0	21,470.9
FD-20	44,842.06	213.0	19.4	2,311.44	866,790	86,679.0	57,786.0	43,339.5	34,671.6	28,893.0
FD-21	38,903.86	213.0	19.4	2,005.35	752,006	75,200.6	50,133.7	37,600.3	30,080.2	25,066.9

S-E-C-R-E-T

Table 13 (continued)

Boiler Tractive Force 1/

1/ Formula used to compute boiler tractive force at various speeds:

$$BTF = \frac{BHP \times 375}{V}$$

$$BHP = \frac{\text{Rated evaporation (lbs. per hr.)}}{\text{Steam utilization (lbs) per indicated hp. hr.}}$$

375 = Conversion factor obtained in converting horsepower to foot lbs. per hr. (60 x 33,000) and miles per hr. to feet per hr. (5280)

V = Speed in miles per hr.

Steam utilization (lbs.) per indicated hp. hr = Value from steam rate table; 200°F superheat (assumed for these specific engines) at maximum steam pressure.

Table 14

Cylinder Tractive Force Factors

Locomotive Type	Piston Speed Factor	Piston Speed (Ft. per Minute) 10 mph	15 mph	20 mph	25 mph	30 mph	Cut-off	Mean Effective Pressure (psi) 1/ 10 mph	15 mph	20 mph	25 mph	30 mph	$\frac{C^2 \times S}{D}$ 2/
SO-17	29.7	297.5	445.5	594.0	742.5	891.0	65	140.15	131.21	117.29	103.38	91.4	347.8
SO-19	29.7	297.5	445.5	594.0	742.5	891.0	70	146.12	135.18	121.27	109.34	97.4	347.8
L	29.8	298.0	447.0	596.0	745.0	894.0	65	140.15	131.21	117.29	103.38	91.4	349.1
Yea	30.1	301.0	451.5	602.0	752.5	903.0	70	132.52	122.60	109.98	99.2	88.3	336.5
Yel	30.1	301.0	451.5	602.0	752.5	903.0	65	127.11	119.0	106.38	93.76	82.94	336.5
Yes	30.1	301.0	451.5	602.0	752.5	903.0	65	127.11	119.0	106.38	93.76	82.94	336.5
Yem	30.1	301.0	451.5	602.0	752.5	903.0	70	132.52	122.60	109.98	99.2	88.3	336.5
E	29.7	297.5	445.5	594.0	742.5	891.0	65	120.13	112.46	100.54	88.61	78.38	347.8
Em	29.7	297.5	445.5	594.0	742.5	891.0	55	126.24	117.29	103.38	91.45	81.51	347.8
Eg	30.1	301.0	451.5	602.0	752.5	903.0	65	120.13	112.46	100.54	88.61	78.38	347.8
Er	29.7	297.5	445.5	594.0	742.5	891.0	55	126.24	117.29	103.38	91.45	81.51	347.8
FD-20	28.7	287.0	430.5	574.0	717.5	861.0	60	143.78	135.26	121.41	106.5	95.85	357.0
FD-21	28.7	287.0	430.5	574.0	717.5	861.0	60	143.78	135.26	121.41	106.5	95.85	357.0

1/ Mean effective pressure at various speeds = Maximum steam pressure x a factor obtained from test plant data and interpolated for specific cut-offs.

2/ C = Cylinder diameter (inches)
S = Length of piston stroke (inches)
D = Driving wheel diameter (inches)

S-E-C-R-E-T

Table 15

Cylinder Tractive Force 1/
(pounds)

Locomotive Type	10 mph	15 mph	20 mph	25 mph	30 mph
SO-17	48,744	45,635	40,793	35,956	31,789
SO-19	50,821	47,016	42,178	38,028	33,876
L	48,926	45,805	40,946	36,090	31,908
Yea	44,593	41,255	37,008	33,381	29,713
Yel	42,773	40,044	35,797	31,550	27,909
Yes	42,773	40,044	35,797	31,550	27,909
Yem	44,593	41,255	37,008	33,381	29,713
E	41,781	39,114	34,968	30,819	27,261
Em	43,906	40,793	35,956	31,806	28,349
Eg	41,781	39,114	34,968	30,819	27,261
Er	43,906	40,793	35,956	31,806	28,349
FD-20	51,329	48,288	43,343	38,021	34,218
FD-21	51,329	48,288	43,343	38,021	34,218

1/ Formula used to calculate cylinder tractive force at various speeds:

$$CTF = \frac{Mep \times C^2 \times S}{D}$$

Mep = Mean effective pressure at various speeds - maximum steam pressure x a factor obtained from test plant data and interpolated for specific cutoffs and speeds. (The Steam Locomotive, Ralph P. Johnson, 1942)

C = Cylinder diameter (inches)

S = Length of piston stroke (inches)

D = Driving wheel diameter (inches)

S-E-C-R-E-T

b. Inventory

There are no recent accurate estimates of the Soviet freight locomotive inventory. Table 16 which lists estimated production and imports of freight locomotives in the U.S.S.R. to 1955 (with updating to 1956 for recently-produced types), provides an indication of present inventory. The list does not include certain older and imported types, despite the fact that some of these are still in use. Since retirements of the types listed are believed to have been small, it is estimated that these retirements would be approximately balanced by older types still in use.

2. Freight Cars

a. Types in Use

Table 17 gives the specifications of Soviet freight cars of which there are believed to be significant numbers. Soviet-built freight cars, other than tank and bitumen bunker cars, generally have wooden sides; a large part of the newer all-steel cars in the U.S.S.R. were imported from the European Satellites.

A high percentage of the freight car park is equipped with automatic couplers of the Willison type, which have a fixed knuckle, compared with the movable knuckle of U. S. couplers. At present, a small number of cars still have hook and link non-automatic couplers. These are probably all the older cars which lack center sills. Most of the Soviet freight cars utilize air brakes similar to the Westinghouse type used in the U. S.

A small percentage of freight cars of each type include a small brakeman's box. This box, which may be either enclosed or open, is used somewhat the same way as a caboose in the U. S.

The weighted average length over buffers per physical car in the Soviet Union, based on the inventory shown in Table 18 is as follows:

Car Type		Weighted Average Length over Buffers in Feet
Box		34.3
Flat		36.5
Open Top		44.6
Tank		36.0
Refrigerator		40.4
	All Cars	37.1

S-E-C-R-E-T

Table 16

Estimated USSR Freight Locomotive Inventory, 1955-56 [1]

Steam Locomotives	Produced in USSR Number	Year First Produced	Imported Number	Imported Country	Imported Year
SO-17 [2]	2,955	1934			
SO-18 [2]	710	1938			
SO-19	1,135	1936			
L [3]	3,911	1945			
Yef [4]			242	US	1915
Yes			106	US	1915-16
Yek [4]			50	Canada	1915
Yel			475	US	1916-17
Yea			2,750 [5]	US	1944
Yem			429 [5]	US	1945
Eu	3,665	1926			
Em	4,445	1932			
Er	2,190	1934			
Er-49			2,000	Hungary, Poland Rumania	1950-present
P-38	2 [6]	1949			
LV	26 [6]	1952			
FD-20		1938			
FD-21	3,218	1941			
Sub-Totals	22,257		6,052		
Total, Steam [7]	28,309				
Electric Locomotives					
VL-19	145	1932			
VL-22	39	1938			
VL-22m	1,094 [8]	1947			
VL-23	9 [9]	1955?			
N-8	11 [9]	1954			
N-O	4 [10]	1955?			
Total, Electric [11]	1,412				
Diesel-Electric Locomotives					
TE-1	294	1945			
TE-2	505 [12]	1948			
TE-3	21 [12]	1953			
TE-4	1	1952?			
TE-5	2	1948?			
Total, Diesel-electric [13]	823				
Grand Total [1]	30,544				

1/ It should be noted that the figures shown here for individual locomotive types represent production and import and do not represent present total inventories of these locomotives, since some of them have been retired. It appears, however, that the retirement rate on these locomotives are probably low. This would probably be balanced by small numbers of old locomotives not shown above which are still in use. Therefore, the totals shown for each major type (steam, electric, and diesel) are believed to approximate present inventory.

2/ Soviet sources normally give specifications only for the SO and SOK or the SO-17 and SO-19 locomotive. It is assumed that the SO-18 is the same as the SO-17.

3/ Originally designated P, for Pobeda.

S-E-C-R-E-T

Table 17

Specifications of Major Soviet Freight Cars 1/

Car Type	Number Of Axles	Capacity Metric Tons	Capacity Short Tons	Tare Short Tons	Inside Dimensions (ft) 1/ Length	Width	Height	Volumetric Capacity, Cu. Ft.
Box Cars								
1936-48	4	50	55	25.0	44.0	8.7	7.9	3157
1928-36	4	50	55	25.8	42.7	8.7	8.2	3157
	4	60	66	24.2	44.0	8.7	7.9	3184
1928-9	2	20	22	12.6	21.5	8.7	8.2	1603
rebuilt 2/	2	20	22	11.5	20.9	8.7	7.2	1377
1914	2	20	22	10.9	22.5	8.7	7.5	1578
	2	16.5-18 3/	18.2-19.8 3/	9.0	20.9	8.7	7.2	1378
Flat Cars								
metal side	4	60	66	24.2	43.7	9.1	1.6	--
wooden sides	4	60	66	24.2	42.3	9.1	1.6	--
no sides	4	60	66	23.2	42.7	10.1	--	--
wooden sides	4	50	55	20.3	42.4	9.1	1.6	--
wooden sides	4	20	22	10.2	29.7	9.0	2.0	--
for manganese	2	20	22	9.8	21.2	9.0	2.0	--
wooden sides	2	16.5-18	18.2-19.8	8.1	29.7	9.0	1.6	--
wooden sides 4/	2	16.5-18	18.2-19.8	7.3	20.6	8.8	1.6	--
Open Top Cars								
Gondola, metal	4	60	66	24.7	39.4	9.5	6.2	2288
Gondola, wooden	4	60	66	25.0	39.4	9.7	6.2	2359
Gondola, metal	4	57	62.8	28.1	42.4	9.4	5.2	2119
Gondola, wooden	2	16.5-18	18.2-19.8	7.9	20.9	9.0	3.9	773
Hopper, wooden	4	50	55	23.2	28.0	9.8	10.1	2094 5/
Hopper, metal	2	25	27.5	13.5	18.6	9.2	9.5	918 5/
Tank Cars								
viscous POL	4	50	55	28.3	--	--	--	1766
POL	4	50	55	24.0	--	--	--	1766
bitumen	4	50	55	27.6	--	--	--	1766
bitumen	2	25	27.5	14.9	--	--	--	883
POL	2	25	27.5	12.1	--	--	--	883
alcohol 6/	2	20	22	19.8	--	--	--	883
alcohol	4	50	55	27.0	--	--	--	1766
acid 7/	4	50	55	25.4	--	--	--	918
sulfuric acid	4	50	55	26.4	--	--	--	883
Refrigerator Cars								
wooden	4	30	33	35.2	43.7	8.5	7.2	2277 8/
wooden	4	30	33	34.7	33.5 8/	8.5	7.5	1826 8/
wooden 9/	4	28.5	31.4	34.7	33.2 8/	8.9	8.5	2263 8/
metal	4	32	35.3	36.4	33.5 8/	8.9	7.9	2083 8/
metal	4	30	33	46.0	48.0	8.4	6.9	2295
wooden	2	19	21	19.8	24.1 8/	8.9	8.5	1681 8/
Bitumen Bunker Cars								
Bunker	4	40	44	24.2-43.1	--	--	--	1483 10/ 1667 10/

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S-E-C-R-E-T

Table 18

Estimated
Soviet Freight Car Park
Beginning 1954

(in Thousands of Physical Car Units)

Capacity (metric tons)	Box	Flat	Open Top 1/	Tank: POL	Tank: Acid & Other	Refrigerator	Bitumen Bunker	All Other	Total
12.5	-	-	-	-	-	*	*	-	*
15.2-15.9	-	-	-	2	-	-	-	-	2
16.5	*	*	-	-	-	-	-	-	*
18	167	60	4 2/	-	-	-	-	-	231
19	-	-	-	-	-	1	-	-	1
20	17	81	4 2/	-	2 3/	-	-	-	104
25	-	-	1 4/	24	1	-	-	-	26
Other, 2-axle 5/	-	-	-	-	-	-	-	10	10
Total, 2-axle	184	141	9	26	3	1	-	10	374
28.5-32.0	-	-	-	-	-	24	-	-	24
40	*	9	-	-	-	-	2	-	11
50	117	11	* 4/	55	4	-	-	-	186
57	-	-	11 6/	-	-	-	-	-	11
60	5	65	110	-	-	-	-	-	180
70 plus	-	*	-	-	-	-	-	-	*
Other, 4-axle 5/	-	-	-	-	-	-	-	13	13
Total, 4-axle	122	85	121 2/	55	4	24	2	13	426
Grand Total	306	226	130 2/	81	7	25	2	23	800

* Less than 500 units.

1/ These are gondola cars (high sided, with flat drop bottoms) unless otherwise specified.

2/ Half cars - open top cars with high sides and solid bottoms.

3/ Alcohol tank cars. Many of these consist of a tank within a 2-axle box car.

4/ Hopper cars - open top cars with high sides and sloping bottoms which open for the discharge of the load. 25X1

6/ Includes a very small number of hopper cars; remainder are gondola cars. 25X1

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It should be stressed that these average lengths would be applicable only where the percentage distribution of the car park, both in terms of car types and in terms of number of axles, approximated that shown in Table 18. Areas which depart significantly from this percentage distribution might have a different weighted average car length.

b. Inventory

In 1954, the Soviet freight car park consisted of an estimated 800,000 individual cars (see Table 18), of which slightly more than 400,000 were 4-axle and slightly less than 400,000 were 2-axle (in 1955 it was announced that almost half of the freight cars were 2-axle). The park is at present in a state of change as the older 2-axle cars are scrapped and replaced by the newer 4-axle cars. It might be noted that the approximately 400,000 2-axle freight cars included in the 1954 park are equivalent in carrying capacity to 145,000 4-axle freight cars (the weighted average capacity of Soviet 2-axle freight cars, based on Tables 17 and 18[1], is 19.1 tons; the weighted average capacity of Soviet 4-axle freight cars is 52.6 tons).

D. Operation of the Railroad

1. Yard Operation

Classification yards on the Trans-Siberian Railroad, with but few exceptions, classify for destination along one line, rather than by direction as on a rail net which dispatches trains in several directions at each large yard. For example, Krasnoyarsk, Ilanskaya, Irkutsk II, Chita and Skovorodino all have classification yards which classify trains only in the direction of the main line. They do, however, perform the useful function of forming blocks of cars or entire trains according to their point of termination along the line, thus allowing maximum movement without reclassification for these "blocks" or trains. The one notable exception is Inskaya yard near Novosibirsk which classifies for several directions;

1/ Note that capacity of 2-axle cars is not the same as capacity of 2-axle units as shown in Table 19. The latter reduces four-axle cars to two-axle units and averages these in with two-axle cars, resulting in a higher figure.

the Trans-Siberian mainline, several points in the Kusnets basin, and the Turkestan Siberian Railroad. Because the Trans-Siberian railroad is for all practical purposes the sole means of east-west freight movement for the cities and towns along the line, all yards along this rail line, therefore, perform a large amount of local freight work. This consists of the breakup and assembly of trains for industrial complexes such as Novosibirsk, Irkutsk, Krasnoyarsk and Khabarovsk to loading and unloading of everything from sewing machines to firewood for Slyudyanka and Ushumun. Yards located at engine depots or turnaround points also have the responsibility for relaying trains through these terminals.

2. Freight Train Operation

a. Types of Freight Trains

The USSR has in recent years organized freight movement and set up a train priority system based on some general train categories. These categories, in order of their frequency of appearance on the Trans-Siberian main line, are as follows:

(1) Local and Sectional Freight Trains

Local freight trains consist of miscellaneous freight trains (sbornyy poyezd), which operate only within one division, dropping off and picking up cars at intermediate points. Sectional trains (gruppovoy poyezd) are made up of blocks of cars destined for no more than three points, and are principally longer distance trains intended for movement through several large centers.

(2) Through Freight Trains (marshruts)

A considerable number of freight trains on the Trans-Siberian railroad operate as marshruts. Marshruts are through trains, generally intended to move more than 500 kms. without reclassification. They are generally divided into two types: (a) Assembled marshruts (stupenchatyy marshrut), which consist of cars loaded at several stations and combined into a long-distance train at an assembly point. Loading dates for such trains are fixed in advance. (b) Shippers' or dispatch marshruts. These are cars sent from one station, by one or more shippers. Assembled marshruts would be employed for miscellaneous freight originating in the industrial areas of the Urals and European USSR; shippers marshruts would be employed for trainloads of one commodity such as coal, timber, grain, and POL which originate in trainload lots at one shipping center. However, even the latter items of bulk freight would in some cases be assembled marshruts because there are also many points which do not produce in trainload lots, such as small timber and grain loading points. The Soviets claim that the use of marshruts reduces transit time by approximately one-half compared with normal train movement, primarily by reducing time in yards for reclassification.

(3) Blue Trains

In 1955 the Soviets introduced Blue Trains, which are marshruts intended to travel an average distance of 610 km. (379 miles) per day, and for distances of over 2,500 km. (1,550 miles) without reclassification.

b. Signalling and Dispatching

Automatic block signals, found from Omsk to Achinsk (750 miles) and Irkutsk to Slyudyanka (79 miles) are operated by a track circuit which is activated by the steel train wheels and axles. The effect is simply that of closing the circuit between the two rails. Thus each train automatically protects itself by tripping each signal it passes, turning it to "stop" and the next signal back to "approach". Under this type of control train movement on the line is authorized by signal indication. In addition, trains enter or leave stations only on authority of enter-station and leave-station signals, controlled by the stationmaster. Locomotives on lines with automatic block signal systems may be equipped with cab signals, which repeat the aspect shown on the track-side signal, and with automatic train control, which stops a train when it passes a restrictive signal without acknowledging the restrictive aspect. In automatic block territory, a green signal authorizes a train to move over the next block at normal speed; a yellow signal authorizes it to move at restricted speed. When a red signal is displayed the chief conductor must wait two minutes and then, if the signal does not change to yellow, must join the engineer and the train must proceed to the next signal at a speed not over 15 km/hr (9.3 mph). Normal operation on the Trans-Siberian is on the right-hand track. However, on sections equipped with automatic block, trains may be dispatched over the left-hand track. In this case, automatic block signalling is suspended and movement is authorized by written train orders.

A so-called "semiautomatic" block system is assumed to be in operation on the Achinsk-Irkutsk section (790 miles). This means that an intermediate control point is placed midway between block stations. This aspect of the signal which is displayed at this intermediate control point is controlled by the station which the train is approaching. Movement is authorized by signals rather than by written train orders. 25X1

[redacted]

c. Double Heading of Trains

[redacted] double heading is 25X1 frequently employed on steam-operated sections of the Trans-Siberian railroad from Novosibirsk eastward. Trains are double-headed from division point to division point as well as on short sections with unusually steep grades. On the triple track section west of Chita, and probably also on the triple track section east of Ulan-Ude, a pusher locomotive is used to help trains over the short section of ruling grade. While double-headed trains are essential for maximum train tonnage in the direction of heaviest freight movement, it is apparent that very often trains are double-headed in the opposite direction simply to balance power, despite the fact that the train may be relatively light and may not, therefore, require the use of two locomotives.

3. Freight Car Operation

a. Average Car Capacity and Tare Weight

Table 19 shows for each freight car type in the Soviet Union the weighted average capacity, and weighted average tare, given both per physical unit and per two-axle unit.

S-E-C-R-E-T

Table 19
USSR
Weighted Average Freight Car Capacity and Tare

Car Type	Weighted 1/ Average Capacity				Weighted 1/ Average Tare			
	Per Physical Unit		Per 2-axle Unit 2/		Per Physical Unit		Per 2-axle Unit 2/	
	MT	Short Tons	MT	Short Tons	MT	Short Tons	MT	Short Tons
Box	31	34.2	22	24.3	14	15.4	10	11.0
Flat	33	36.4	24	26.5	13	14.3	10	11.0
Open Top	57	63.0	29	32.0	21	23.2	11	12.1
POL Tank 3/	41	45.2	25	27.6	19	21.0	11	12.1
Refrigerator	29	32.0	15	16.6	31	34.2	17	18.8
Weighted Average 4/	37	40.8	24	26.5	16	17.7	11	12.1

1/ Average for each car type is weighted on the basis of data for the various capacities of cars within that type, as shown in Table 17.
2/ In this calculation, a 4-axle car is reduced to two 2-axle cars.
3/ Capacity in terms of water. Calculations exclude alcohol, acid and chlorine tank cars.
4/ Including all cars shown in Table 18.

b. Net Tons per Car

The weighted average net load per car, by major commodity types, is shown in Table 20. For each commodity the ratio of norms (required tonnage) for load per car to car capacity were obtained from Soviet sources, and the ratios were weighted on the basis of the distribution of car types and capacities shown in Table 18. The resultant ratios shown in Table 20 were then multiplied by the average car capacity in Table 19 to provide an average net load. In the instances where data was available from other sources, it appears that the Soviets do load cars to norm. While there is some underloading of cars, it is also permissible to overload cars slightly, which is believed to balance the underloading.

Soviet railroad regulations state that the load in a car should not, as a rule, exceed the carrying capacity of the car. Excess load discovered when a car is weighed need not be unloaded if it does not exceed the carrying capacity of 16.5, 18, and 20 metric-ton cars by 0.5 metric tons; 50-ton boxcars by 3.0 tons; and for all other 4-axle cars, by 1.0 tons. Recently, the Soviets have raised the permissible load on some 50 metric-ton box cars to 60 metric tons. This is painted on the side of the car where the 50-ton capacity is shown normally, and the 60-ton capacity is shown in parentheses.

S-E-C-R-E-T

Table 20
USSR
Weighted 1/ Average Net Load Per Car
By Major Commodity Types

Commodity	Car Type	Weighted 1/ Ratio of Net Load to Car Capacity (%) Per Physical Unit	Per 2-axle Unit 2/	Weighted 1/ Average Net Load Per Physical Unit MT	Per Physical Unit Short Tons	Per 2-axle Unit 2/ MT	Per 2-axle Unit 2/ Short Tons
Grain	Box	97	98	30	33.0	22	24.3
Coal	Box	101	102	31	34.2	23	25.4
	Open Top	101	101	57	63.0	30	33.1
	Flat	81	72	27	29.8	17	18.8
Coke 3/	Box	87	82	27	29.8	19	21.0
	Open Top	70	69	40	44.1	20	22.0
Timber and Lumber	Box	87	85	27	29.8	19	21.0
	Open Top	63	63	36	39.7	19	21.0
	Flat	89	85	30	33.0	20	22.0
Ore	Open Top	100	100	57	63.0	29	32.0
POL	POL Tank	83	82	34	37.5	20 4/	22.0 4/
Mineral Building Materials	Box & Open Top	100	100	39	43.0	25	27.6
	Flat	84	84	28	30.9	20	22.0
Iron & Steel	Box, Flat, Open Top	100	100	37	40.8	25	27.6
Meat & Perishables (Includes Canned Foods)	Refrigerator	70	70	20	22.0	11	12.1
	Box	83	79	25	27.6	17	18.8
Miscellaneous Freight 5/	All Types	42	42	16	17.7	10	11.0

1/ For each commodity, the ratio of loading norm for each car type to car capacity was calculated. For each car type, these ratios were then weighted on the basis of the distribution of car capacities shown in Table 17.

2/ In this calculation, a 4-axle car is reduced to two 2-axle cars.

3/ Loading of coke on flat cars is stated in norms for only 2-axle types. In this case, loading approximates 74 percent of marked car capacity.

4/ Soviet figures on tonnage of POL loaded per car are given in terms of a unit which is roughly equivalent to a one-axle car. This, therefore, results in Soviet figures of about 10 tons of POL per "car", compared with the 20-ton figure shown in this table, which is the figure for a two-axle car unit. Carloadings of tank cars are calculated according to the capacity of the car as follows:

Tank Car Capacity (MT)	Number of Carloading Units
Up to 20	1
20 to 25	2
26 to 40	3
Above 40	4

On this basis, the normal 4-axle tank car, with a capacity of 50 metric tons in terms of water, would be considered as 4 carloads. If loaded with POL (which has an average weight about 80 percent of an equal volume of water), it would be carrying 40 metric tons per carload.

5/ It is estimated that military freight, other than items listed above, loads to approximately the same tonnage as miscellaneous freight.

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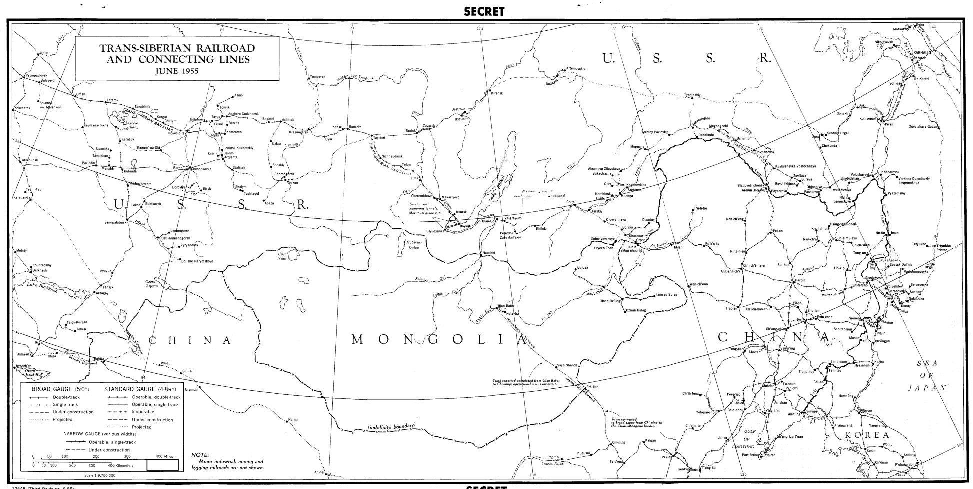

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