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RAIL AND MOTOR OUTLOADING CAPABILITY STUDY, FORT IRWIN, CALIFOR--ETC(U)
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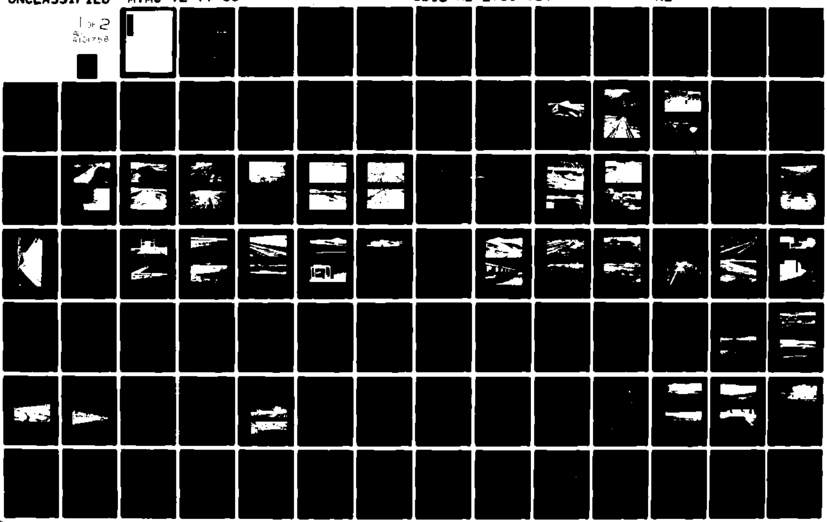

MTMC REPORT TE 77-63

RAIL AND MOTOR OUTLOADING CAPABILITY STUDY

FORT IRWIN, CALIFORNIA

May 1978

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TRANSPORTATION ENGINEERING AGENCY

Newport News, Virginia 23606

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EXECUTIVE SUMMARY

1. SCOPE

The Military Traffic Management Command conducted a survey of the rail and motor facilities at Fort Irwin, California, from 19 through 23 September 1977, to determine the installation's outloading capability. Since no rail and motor facilities exist off post within a 25-mile radius of the installation, those facilities within a 35-mile radius were included in the survey.

2. FINDINGS

The primary finding is that, although Fort Irwin has no trackage, nearby rail systems can support relatively large-scale outloading operations. Fort Irwin, however, does have access to a spur at Manix.

The Atchison, Topeka, and Santa Fe (ATSF) Railroad has both a new and an old classification yard in Barstow. The new yard has 113 miles of track. The Union Pacific (UP) Railroad has a 970-car classification yard at Yermo, near Barstow. Both UP and ATSF have other sidings or spurs in the area outside their yards that can be used for outloading. The US Marine Corps Supply Center near Barstow has a large amount of trackage, some of which might be available during a mobilization. This trackage was not included in the recommended plan since all of it might be required by the Marine Corps. The condition of the trackage in the Fort Irwin area is generally good; all trackage is usable, but the US Army, of course, has no control over maintenance of the trackage. No outloading plans have been prepared. The current capability has a potential of thirty-four 60-foot railcars[1/] per day from the Manix spur (25 miles east of Barstow), but lack of trained personnel, blocking and bracing materials, and materials-handling equipment (MHE) limits the current capability to 10 railcars per 8-hour day. Fort Irwin is 179 miles from the nearest port of embarkation (POE) to which roadable equipment can be driven, but for Atlantic coast POEs all equipment must be moved by rail. The major mobilization unit at Fort Irwin is a California National Guard infantry division (mechaized, minus one brigade). A total of 1,218 railcars would be required

[1/] Sixty-foot lengths were used in this report as the average railcar length. To determine the equivalent number of railcars at a different desired length, multiply the number of 60-foot cars by 60 and divide by the desired length in feet.

to transport the division equipment. The analysis was based on outloading rates that would produce about 50, 100, 150, or 200 railcars per day. The mobilization outloading rate that can be achieved with the recommended plan, Plan 4, using all available trackage except the US Marine Corps Supply Center, is 210 60-foot railcars per 24-hour day (table 1). However, if the trackage at the US Marine Corps Supply Center were also used, the mobilization outloading rate would be 258 60-foot railcars per 24-hour day. Other optional outloading rates, producing from 50 to 150 railcars per day, are presented in this report.

Representatives of both the ATSF and the UP determined which of their facilities could be used for outloading by Fort Irwin. At present, tracked vehicles can be outloaded only at the Manix spur. The tracked vehicles must be driven 26 miles cross-country and under a dryland bridge on Interstate Route 15.

The motor outloading capability at Fort Irwin is severely limited. Four concrete end-loading ramps are on post, but the limiting factor is the shortage of semitrailers in the area. The two commercial truck companies within the 35-mile radius have no 100,000-pound capacity trailers and only two 40,000-pound capacity trailers. The current capability has a potential outloading rate of 32 trucks per day, but lack of personnel, blocking and bracing equipment, and MHE limits the current capability to about 10 trucks per day. The mobilization capability is about the same rate unless trucks can be brought in from outside the vicinity since the constraint is the availability of trucks and not hours in the day or number of personnel. Of course, motor outloading could be used to supplement the rail move since a greater outloading rate could be achieved by driving the trailers (loaded with nonroadable equipment) round trip between Fort Irwin and rail facilities in Barstow instead of driving the trailers one way to the POE.

3. CONCLUSIONS

a. All trackage in the vicinity of Fort Irwin is in generally good condition and usable; however, some ramp construction is required. Current rail outloading is limited not by trackage but by lack of trained personnel. The mobilization rail outloading is limited by insufficient end-loading ramps, blocking and bracing materials, bridgeplates, and small handtools, and by lack of outloading plans.

b. Ample trackage exists in the area to outload the division (minus one brigade) in 10 days. The recommended outloading plan, Plan 4, produces a rate of 210 railcars per day.

TABLE 1
RAIL AND MOTOR OUTLOADING CAPABILITY

Rail				
	Number of Cars (60-Feet Coupler to Coupler)			Current Constraints
	Total	Flats	Box	
Daily Current	10	8	2	Potential exists for 34 flats per day, but lack of trained personnel and blocking and bracing materials limits capability.
Daily Mobilize	156	138	18	Lack of blocking and bracing materials, bridgeplates, and small handtools.
Plan 4*	210	192	18	Lack of blocking and bracing materials, bridgeplates, and small handtools. Three portable timber ramps are required at a cost of $7,500. Potential exists for another 48 cars if 6 ramps at the USMC Supply Center are used.

Motor		
	Number of Trailers	Current Constraints
Daily Current	10	Potential exists for 32, but lack of trained personnel and MHE limits capability.
Daily Mobilize	96	The commercial inventory in the vicinity is 102 trailers, including only 2 lowboys, so lowboys will have to be brought in from elsewhere for hauling tracked vehicles and nonroadable equipment.

*Recommended plan. Outloads division (minus one brigade) in 10 days.

c. The ATSF and UP classification yards should be used to classify incoming empty railcars destined for Fort Irwin's use, as to type, length, height, and position in string, before movement to loading sites.

d. The ATSF and UP representatives did not express any reservations regarding the outloading of Fort Irwin units concurrently with other local commercial demands.

e. For administrative-type moves, when leadtime is plentiful and costs must be considered, special-purpose railcars (such as bi-level autoracks, trailer-on-flatcar (TOFC), and container-on-flatcar (COFC) cars) are more cost-effective than the standard types and should be used.

f. For mobilization moves, when time is more critical than costs, the use of special-purpose railcars may not be possible because of the short notice and the relatively short supply of these high-demand cars.

g. Estimated minimal cost for portable timber ramp construction, to achieve the 210 daily rate, is $7, 500. Costs for bridgeplates, blocking and bracing materials, and small handtools are additional.

h. Capability of motor outloading facilities at Fort Irwin for loading commercial flatbed semitrailers exceeds the probable available supply of trailers for both current and mobilization capabilities.

i. Tracked vehicle movements are restricted to Manix, which limits outloading capability, except for a very small number that could be trucked to a railhead.

j. Support from the USMC Supply Center at Yermo and Nebo would be questionable in case of mobilization.

4. RECOMMENDATIONS

a. Undertake those items listed in section II, paragraph D5, "Physical Improvements and Additions." These improvements will produce a rail outloading capability of 210 railcars per day and will insure a continued effective rail system.

b. Prepare a detailed unit outloading plan, using the simulation in appendix B as an example, that specifies unit assignments at load-out sites and movement functions.

c. Provide advance training for blocking and bracing crews.

d. Coordinate with the ATSF and UP as early as practicable for the placement of portable timber ramps on their trackage and for the order of 1, 218 railcars in the event of mobilization.

e. Begin weighing equipment to be outloaded several days before actual outloading begins.

f. Use special-purpose railcars (such as bilevel autoracks for small vehicles, TOFC for semitrailers and vans, and COFC for MILVANs) for administrative-type moves and, as available, for mobilization moves.

g. Keep abreast of ATSF and UP railroads' plans regarding the selected sites for outloading, as these tracks are essential for the support of a major outloading.

h. Investigate potential trails for driving tracked vehicles to other sites, particularly UP Yermo and Daggett Airport. This will also involve property leasing from and environmental effects on, the nearby communities.

I. INTRODUCTION

A rail and motor outloading study of Fort Irwin, California, located in the Mojave Desert near Barstow, was conducted by the Military Traffic Management Command Transportation Engineering Agency, Newport News, Virginia, during the period 19 through 23 September 1977. The study was to include estimates for expenditures to maintain or upgrade present capabilities, as well as consideration of commercial rail and motor facilities within a 25-mile radius. However, since no rail facilities exist within a 25-mile radius of the installation, those facilities within a 35-mile radius were surveyed. Conversely, no motor outloading facilities exist within a 35-mile radius of Fort Irwin, but the motor facilities on post were examined.

Findings and recommendations contained in this report are based on analysis of data obtained during the field study and on other pertinent information relating to installation activities at that time. Problems incurred in implementing the recommendations should be referred to MTMCTEA for resolution.

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II. ANALYSIS OF COMMERCIAL AND GOVERNMENT RAIL FACILITIES WITHIN THE FORT IRWIN VICINITY

A. GENERAL

Discussions with personnel at Fort Irwin and meetings with officials of the Union Pacific and Santa Fe Railroads concerning rail outloading revealed that large-scale rail operations have not occurred within this area in recent years. Fort Irwin, now on inactive status, is operated by the California National Guard (CNG). The CNG maintains a Mobilization and Training Equipment Site (MATES), with a stockpile of equipment for training NG units. These units, by their nature, require little ability to move as organized units. No trackage exists within the post's area, but trackage in the surrounding area yields a large rail outloading capability. Factual data about locomotive switching and blocking and bracing times were gathered from other studies. Loading, blocking and bracing, and inspection times were obtained from an actual field test, the REFORGER 76 exercise.

Throughout this report the following definitions are used to describe condition of trackage: good - requires no maintenance; fair - usable but requires maintenance; poor - unusable, requires major maintenance.

B. RAIL FACILITIES

The relative locations of the rail facilities available in the vicinity of Fort Irwin are illustrated in figure 1 and described in table 2. A survey of all sites that possibly could be used for outloading equipment revealed that seven sites currently are usable for end-loading vehicles, but only five of these sites could be relied on for mobilization capability. None of the sites has lighting available, and all have surfaces comprised mostly of graveled dirt or sand. The sites surveyed are listed below.

1. Manix

This site is the closest loading facility to Fort Irwin and the only one where tracked vehicles, mainly tanks, can be driven overland. This facility is about 20 miles south of Fort Irwin via the tank trail and 25 miles east of Barstow. Rail service is provided by the Union Pacific Railroad Company.

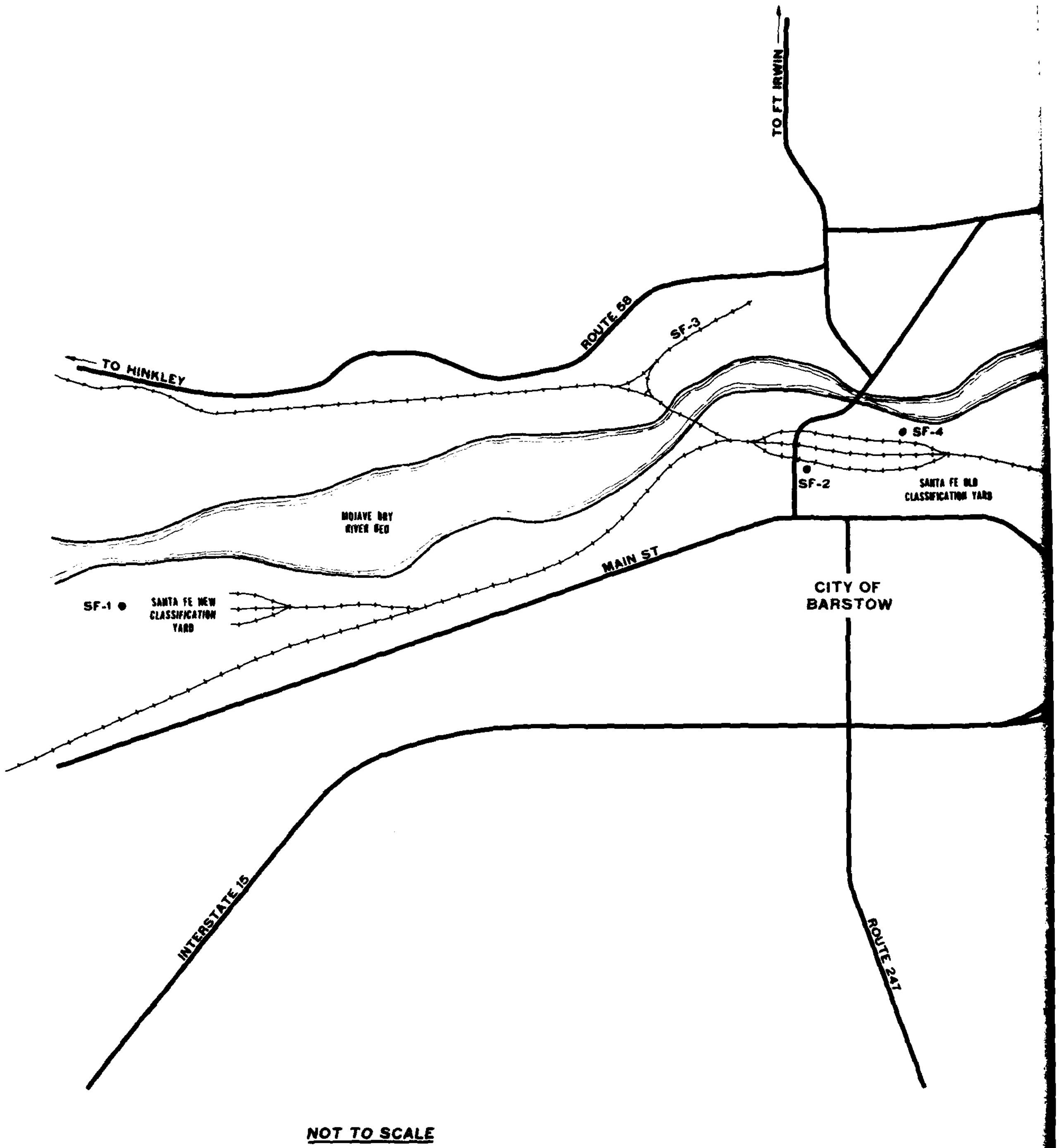
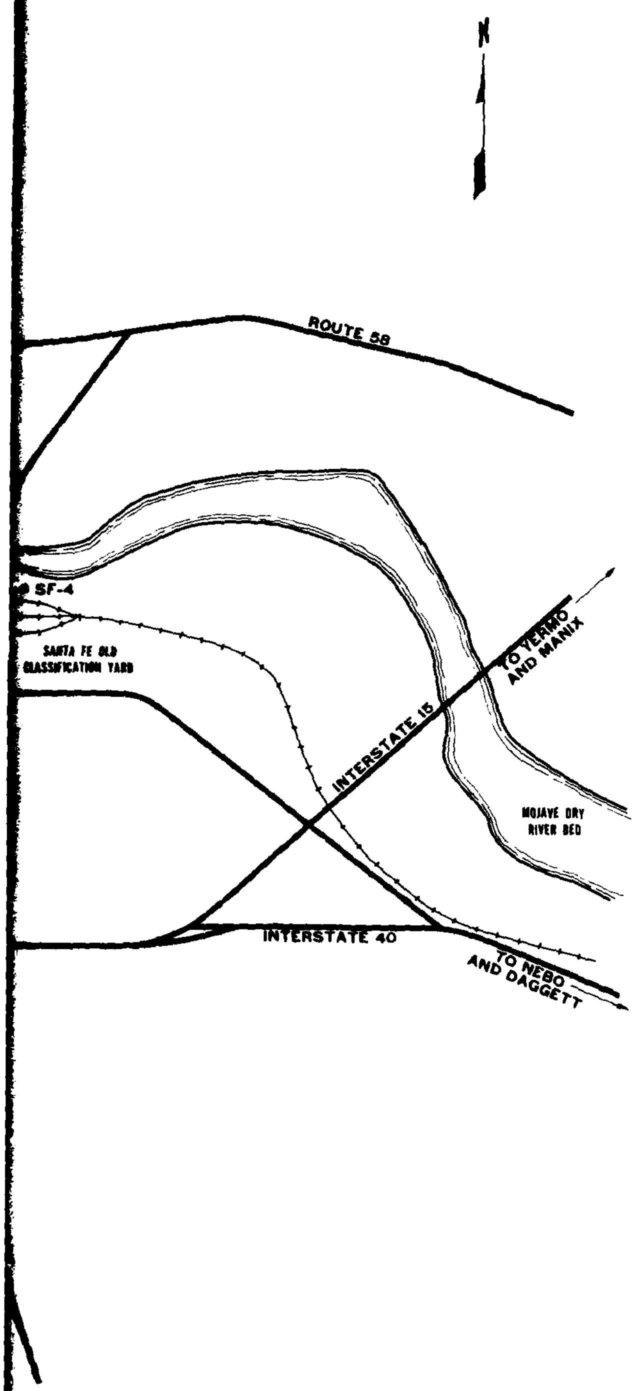


Figure 1. Barstow vicinity.


N
ROUTE 58
SF-4
SANTA FE OLD
CLASSIFICATION YARD
INTERSTATE 15
TO YERMO
AND MANIX
MOJAVE DRY
RIVER BED
INTERSTATE 40
TO NEBO
AND DAGGETT

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2

TABLE 2

RAILROAD FACILITIES WITHIN THE VICINITY OF FORT IRWIN

Location Railroad Figures	Road Distance From Fort Irwin (Miles)	Type of Trackage Available	Type of Ramps	Lighting	Surface Conditions	Staging Area	Storage Capacity Railcars 60-Foot Lengths	Road Access to Site	Remar
Union Pacific Manix Figures 2 through 6	20 (trail) 63 (road)	Spur	Concrete, end	None	Lightly graveled sand	Good	29	Good	Petroleum pipel side north end beneath surfac Room for adding
Union Pacific house track west/east Figures 7 through 9	48	Classification yard	None, side unusable	None	Coarse, hard sand with fine gravel	Fair	15 east 15 west	Good	Portable timbe needed on each of road betwee
Union Pacific cleaning track Figures 7, 10, and 11	47	Spur	Dirt, end	None	Coarse, hard sand with fine gravel	Excellent	23	Good	Large staging a between main an cleaning tracks
Union Pacific wye Figures 7 and 12	48	Spur	Dirt, end	None	Coarse, hard sand with fine gravel	Good	4	Good	Ramp unusable i condition.
Union Pacific Marine tail track Figures 7, 13, and 14	46	Spur	Dirt, end	None	Solid dirt and gravel	Excellent	25	Good	Ramp needs mino
ATSF 3 Figures 15 through 19	34	Spur	Concrete, end	None	Firm sand slightly graveled road	Good alongside track	40	Good	Good track, co with sand and w
ATSF 2 Figures 19 through 21	37	Spur	Wood and dirt	None	Dirt and gravel	Poor	7	Fair	Unused, good tr
ATSF 4 Figures 19, 22, and 23	37	3 Spur	Side	None	Fine gravel	Good, but small	6 each	Fair	Unused, good t
ATSF 1 Figures 24 through 27	38	Spur	Dropped flatcar	None	Gravel	Excellent	5	Good	Excellent trac
Union Pacific USMC Yermo Figures 28 through 32	45	Spur	Concrete, end	None	Solid dirt	Good	7 #446 8 #447 8 #448	Good	446 bilevel, a level; no trac vehicles
Union Pacific USMC Yermo Figures 28 and 33 through 35	45	Spur	Concrete, side	None	Heavily graveled sand	Good	3 #17 3 #18 3 #19	Good	
Union Pacific USMC Yermo Figures 28 and 36	45	Spur	None	None	Solid dirt	Good	70	Good	Heavy-duty st crane loading
ATSF USMC Nebo (S-211) Figures 38 and 39	41	Spur	Concrete, end	None	Lightly graveled sand	Good	15	Good	No tracked ve
ATSF USMC Nebo (S-45) Figures 38 and 40	41	Spur	Concrete, end	None	Lightly graveled sand	Good	5	Good	
ATSF Daggett Airport Figures 45 through 49	51	Spurs north south	None concrete end, side	None	Lightly graveled sand	Good	8 north 14 south	Good	Additional thr can be outload south track be switch
ATSF Hinkley Figures 41 through 44	46	Spur	None	None	Solid dirt	Good	16	Good	Portable timbe ramp needed

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ks
line along-   of track   ce.   ng spurs
er ramps   h side   en tracks
area   and   ks
in present
inor repairs
covered   d weeds
trackage
trackage
rackage
, and tri-   racked
straddle   ing
vehicles
three cars   loaded on   beyond
imber   d

The site, consisting of a spur adjacent to a 5,400-foot passing track and a main line, has a capacity of twenty-nine 60-foot cars. It has a concrete end ramp, which is surrounded by lightly graveled sand. No lighting exists here and the staging area is good. A problem exists because of a petroleum pipeline buried alongside this trackage. Heavy vehicles must be moved with care so that they do not dig away the sand and damage this line. The track itself is in good condition[2/] and no repairs are necessary, as shown in figures 2 through 5.

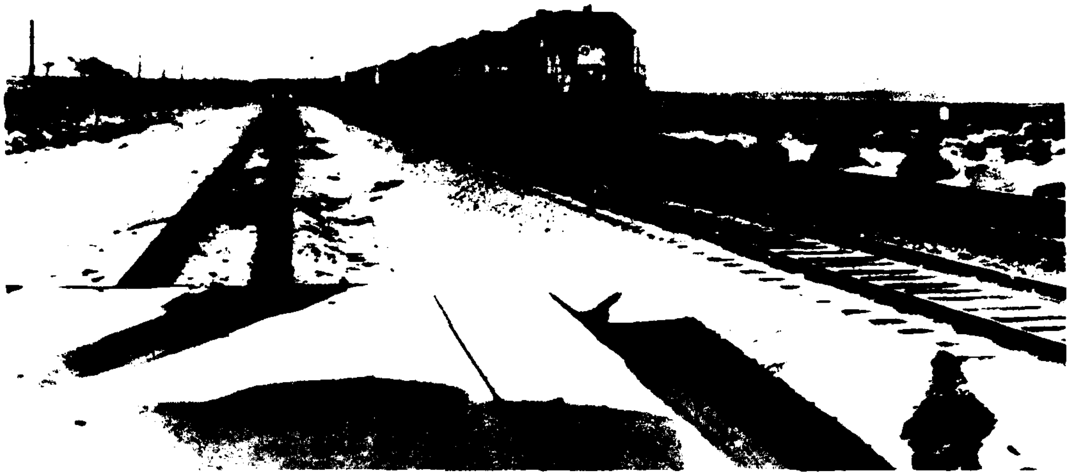

Figure 2. Manix (looking east from ramp).

Highway transportation to this site is by way of Barstow on old Route 466. Since tracked vehicles would rip up this road, they must traverse the terrain between Fort Irwin and Manix. A path for tracked vehicles was leased from individual property owners. The tracked vehicles also go under an I 15 land bridge (fig 6), and across Route 466. To cross Route 466, protection such as pierced planking should be used. The site has room for building additional spurs. The district engineer from Union Pacific stated that sufficient right-of-way existed for two additional spurs at a cost of $30 per foot.

2/ See appendix A, which is reproduced from Code of Federal Regulations.

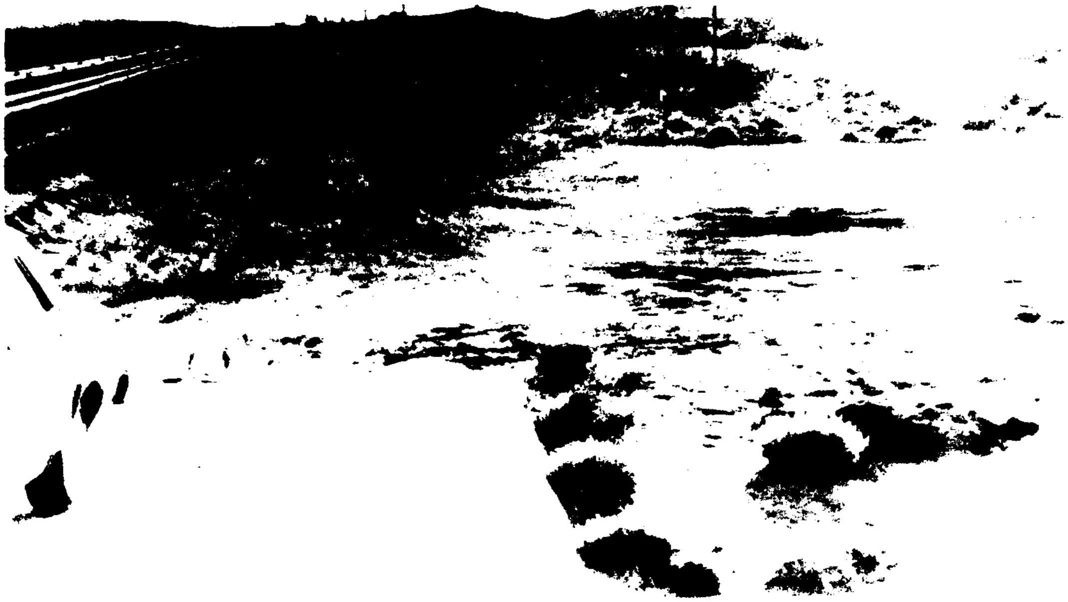

Figure 3. Manix, end of ramp and staging area along Route 466 (looking west).

Figure 4. Manix (looking west toward ramp).

Figure 5. Petroleum pipeline warning sign (looking east at Manix).

Figure 6. Dryland bridge at Interstate 15 (looking north).

2. Union Pacific - Yermo

The Union Pacific Railroad classification yard at Yermo is 11 miles due east of Barstow along old Route 466. This site has three spurs--cleaning, "Y," and Marine tail tracks--that can be used for end loading and a house track that can also be used with some modification. The total capacity of these tracks is eighty-four 60-foot cars (fig 7).

The house track (figs 8 and 9), on the eastern part of the yard, is bisected by a dirt road. Both ends of the track are connected. With portable timber ramps on each side of this road, the track would have a capacity of 15 cars on each end. A small side-loading dock is at the western end of the yard, but is it not useful. The staging area is fair and road access is good.

The cleaning track (figs 10 and 11), located on the western part of the yard, has a good, dirt end ramp. The track is in good condition and an excellent staging area lies between the main and cleaning tracks. The track capacity is twenty-four 60-foot cars. Road access is good.

The "Y"-track (fig 12), located on the southern end of the yard, has a dirt and timber end ramp that is in poor condition. Also at this end of the yard is an unusable side ramp. The staging area and road access are good. The track capacity is four 60-foot cars. In general, the surface conditions are coarse, hard sand mixed with fine gravel. No lighting exists at any of the spurs. Access is provided by old Route 466.

The marine tail track, located at the northwestern part of the yard, has a dirt ramp at one end that needs minor repairs. This track, shown in figures 13 and 14 is in good condition and its staging area is excellent. The track capacity is twenty-six 60-foot cars.

3. Atchison, Topeka, and Santa Fe - Barstow

The ATSF has three usable sites for end loading railroad cars and one site for side loading cars. The end-loading sites are the old yard in Barstow, the spur by the radio tower north of Barstow, and the new massive classification yard just west of Barstow. The side-loading site would be those ramps in the old yard. Unfortunately, only one small spur in the new classification yard can be used.

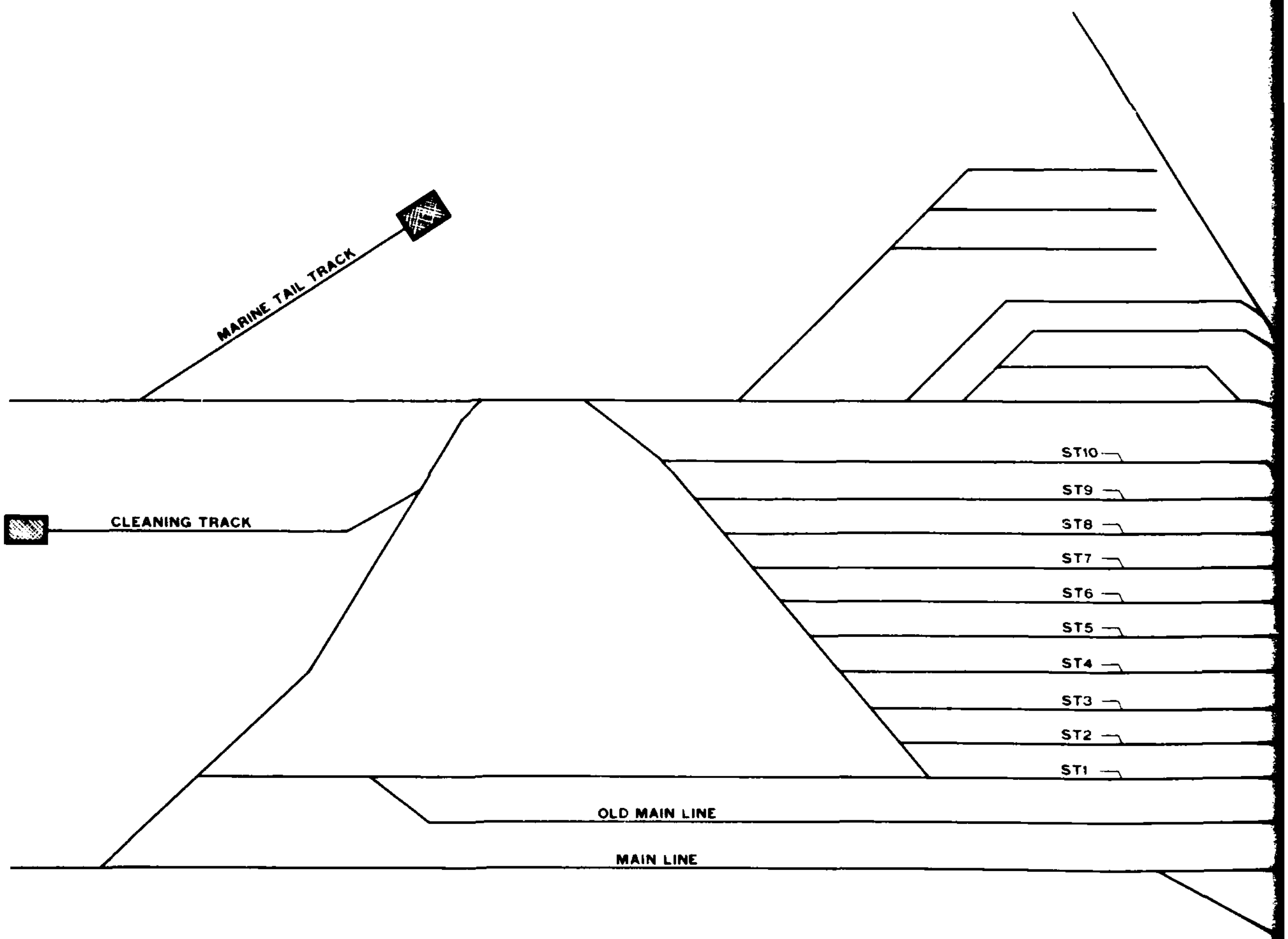

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Figure 7. Yermo - Union Pacific Railroad.

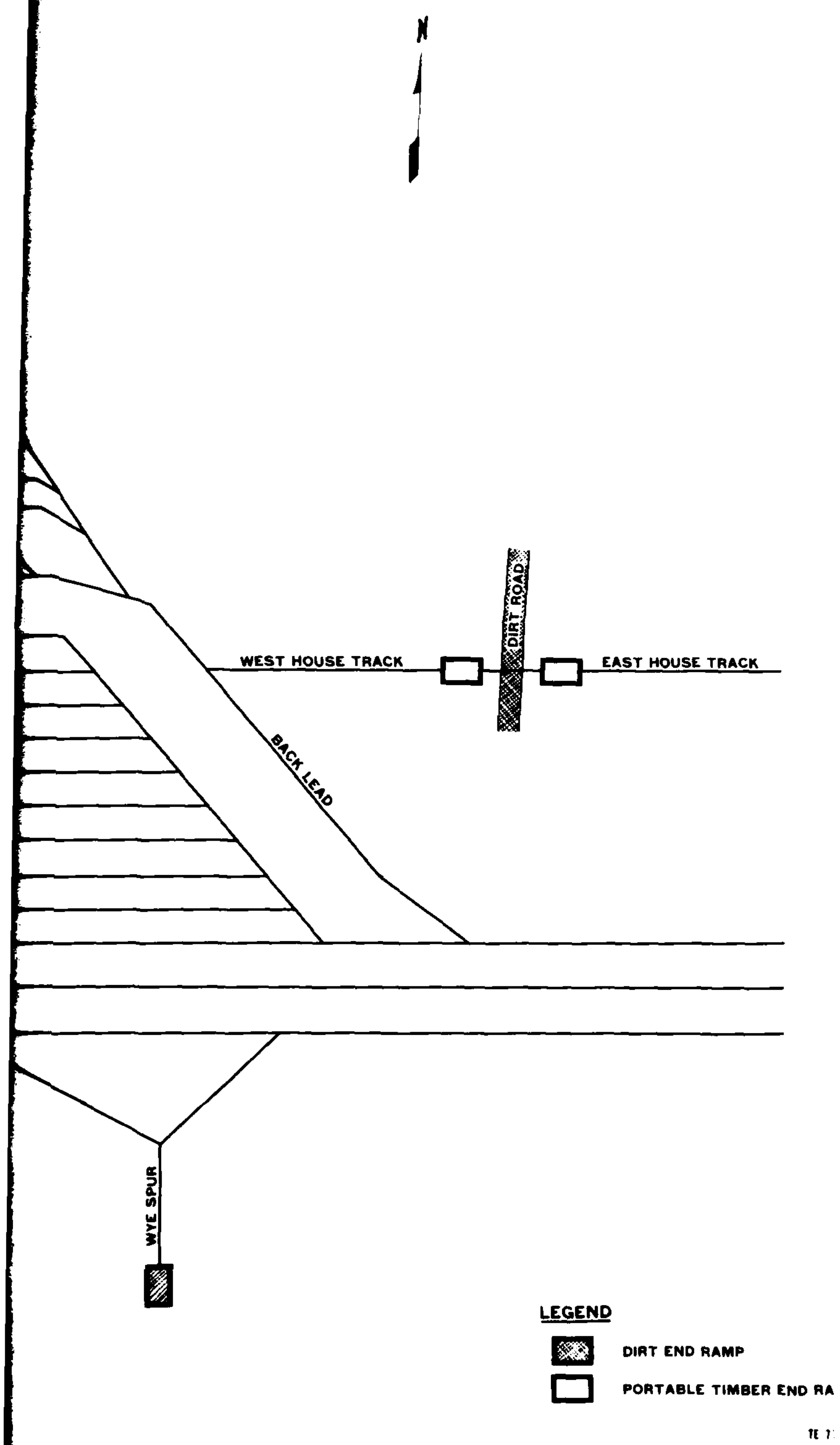
N
DIRT ROAD
WEST HOUSE TRACK
EAST HOUSE TRACK
BACK LEAD
WYE SPUR
LEGEND
DIRT END RAMP
PORTABLE TIMBER END RA
TE 7

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Figure 8. House track and side-loading ramp (looking east).

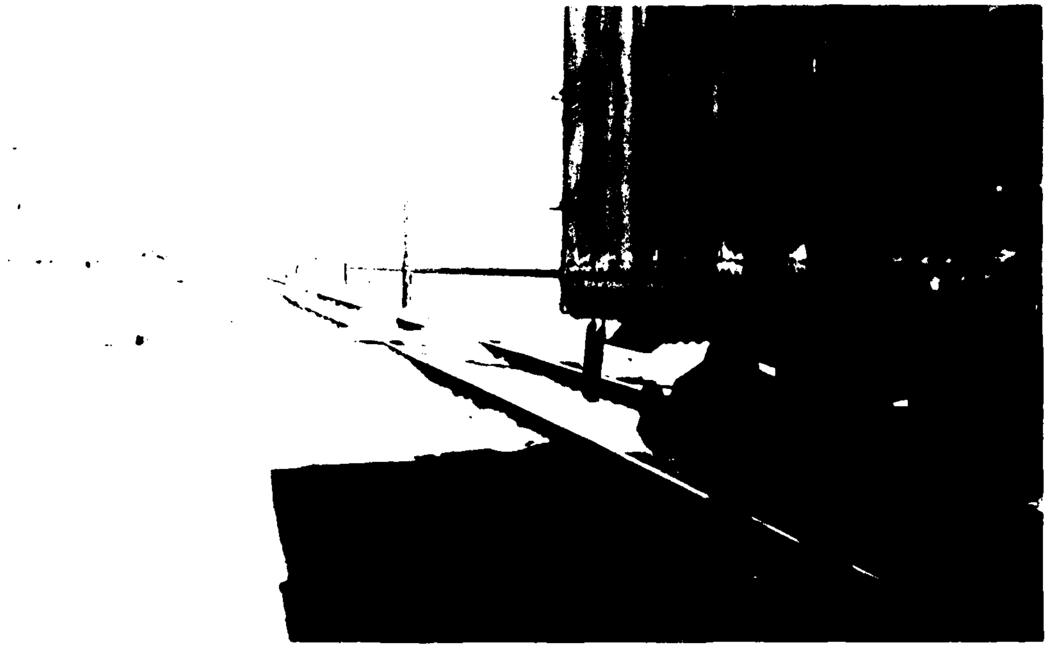


Figure 9. House track and bisecting road (looking east).

Figure 10. Cleaning track ramp (looking north).

Figure 11. Cleaning track and staging area (looking east).

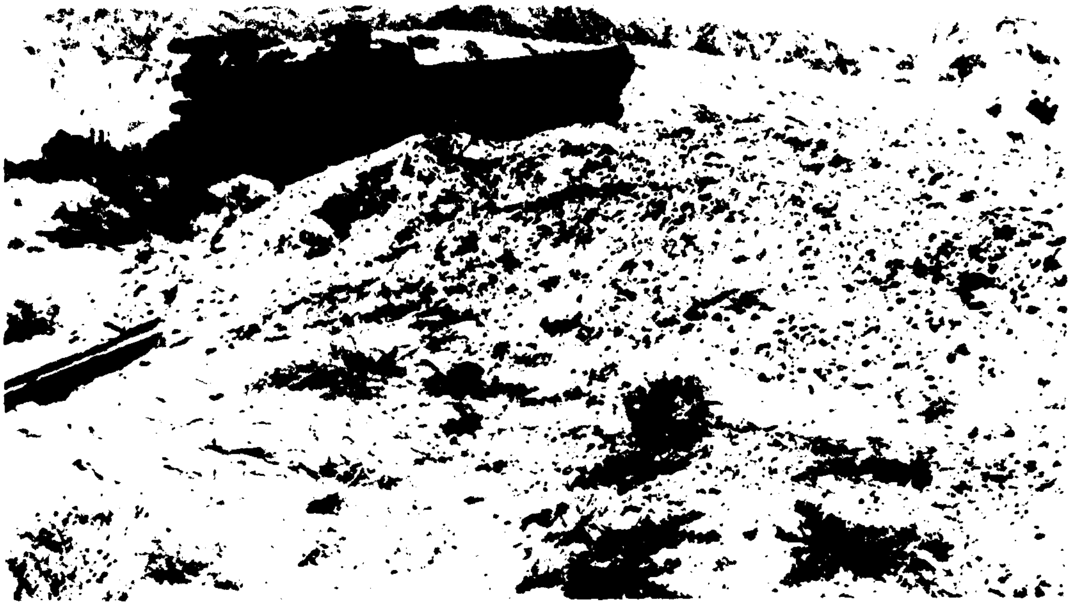


Figure 12. Dirt ramp at wye track.

Figure 13. Marine tail track (looking southwest).

Figure 14. Staging area at marine tail track (USMC Yermo in background) (looking west).

The major outloading spur would be the one by the radio tower (SF-3), with a capacity of fifty 60-foot cars; however, loading procedure dictates a 40-car limit. This site has a concrete end ramp and the track is in good condition. There is no lighting here, but the staging area is good. The only shortcoming of this site is its nearness to a flood dike on the eastern side of the ramp. Road access is excellent from Fort Irwin, which is 34 miles away. Figures 15 through 18 illustrate this site.

In the old classification yard (fig 19), the only available end-loading dock (SF-2) is made of wood and dirt and is in fair condition. The surrounding surface is dirt and gravel. There is no lighting, and the staging area is extremely small. The capacity of the spur is seven 60-foot cars. Road access is good (37 miles from Fort Irwin) and the track is in good condition (figs 20 and 21). Also at this site are three spurs and two side-loading ramps; each spur has a capacity of six 60-foot cars (SF-4). The track condition is good, but the staging area is small. These spurs could be used as side-loading tracks for boxcars or for end loading, with a portable timber ramp at one end (figs 22 and 23).

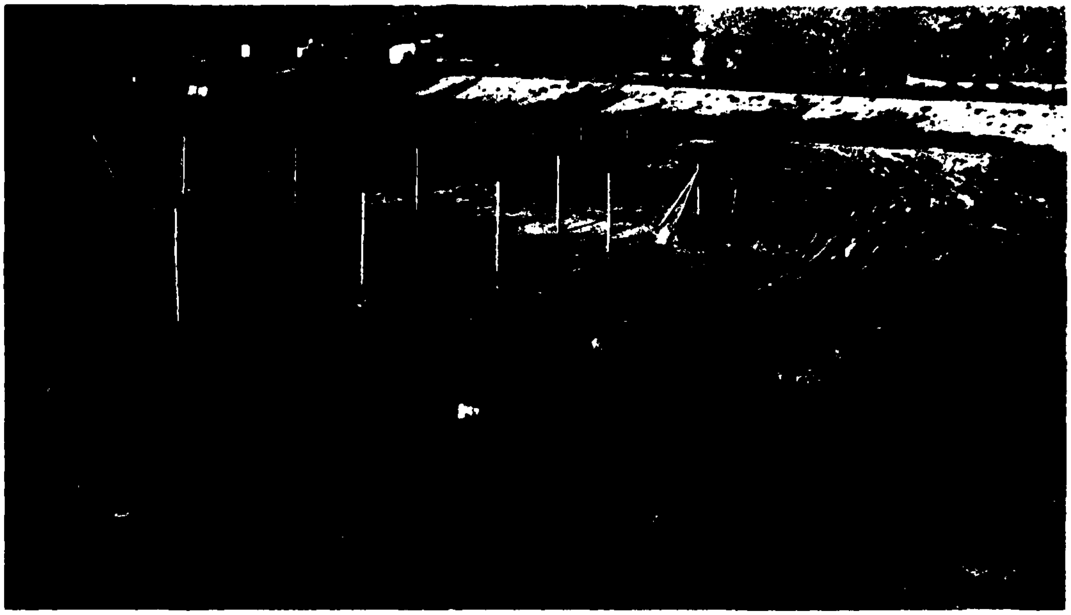


Figure 15. Access route to SF-3, radio tower spur (looking northeast).

Figure 16. SF-3, radio tower spur, with flood dike in background (looking northeast).

Figure 17. SF-3, radio tower spur (looking west).

Figure 18. SF-3, radio tower spur (looking southwest).

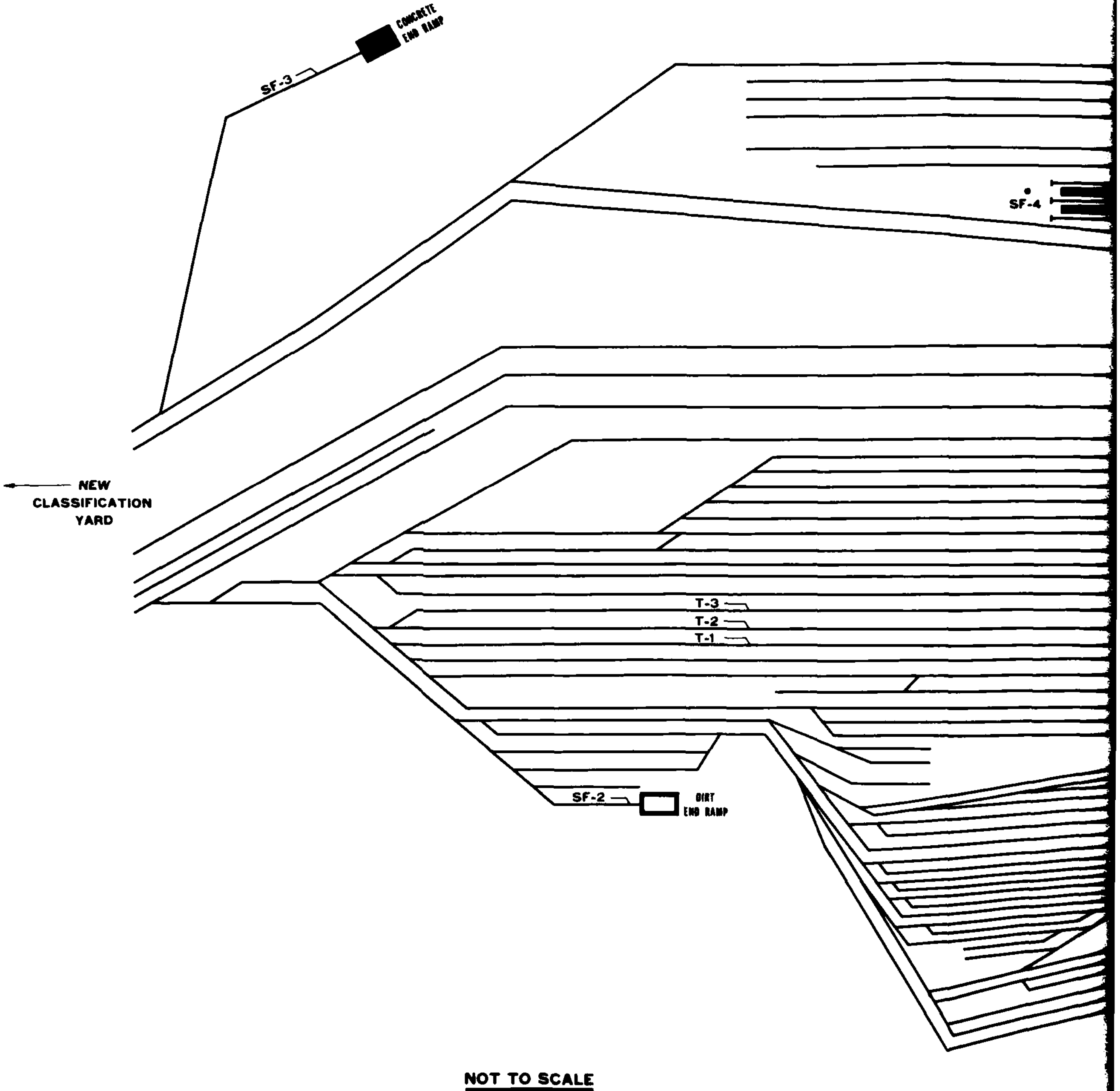
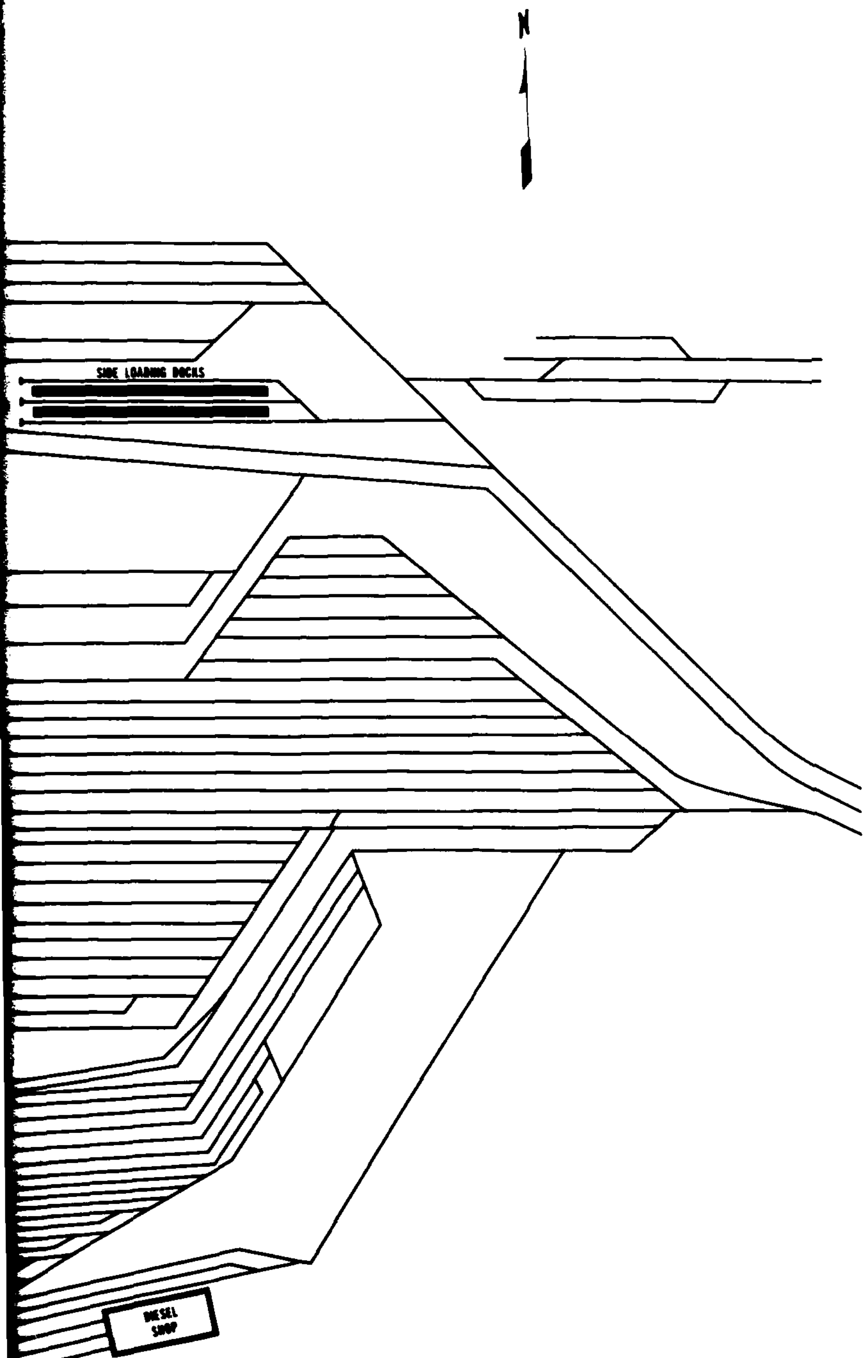


Figure 19. ATSF - old classification yard.



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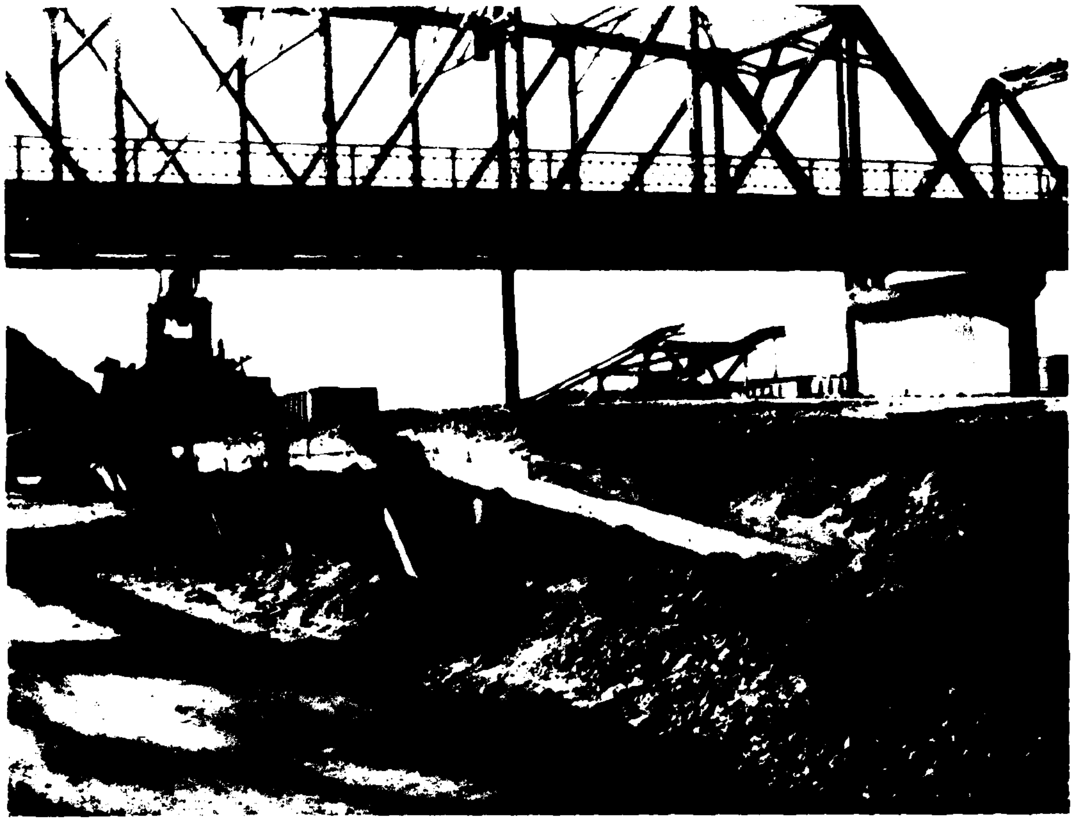

Figure 20. Wood and dirt ramp at SF-2 (old yard).

Figure 21. Staging area at SF-2 (old yard) (looking east).

Figure 22. ATSF side-loading tracks (old yard) (looking west).

Figure 23. ATSF side-loading tracks with concrete ramps (old yard) (looking east).

ATSF has a huge computer-controlled classification yard just outside of Barstow (fig 24). For practical purposes, only one spur, with a capacity of five 60-foot cars, is available for end loading (SF-1).

Figures 25 and 26 show a flatcar dropped on one end to serve as an end ramp. The surface is a gravel layer topping a dirt substrate. The staging area is excellent and road access is good. The track (fig 27) is in excellent condition and is 38 miles distant from Fort Irwin. The total capacity of all three ATSF sites is fifty-two 60-foot cars.

4. <u>USMC - Yermo</u>

The US Marine Corps Supply Center consists of two locations--Yermo and Nebo. Yermo is 9 miles due past of Barstow along I 15 and old Route 466 and 45 miles from Fort Irwin. About 20 miles of trackage is located on this base (fig 28). Rail service to this base is provided by the Union Pacific Railroad Company, and the base has its own switch engine and rail crew. This base has only three spurs (S-446, S-447, and S-448), located along the northwest portion of the base, with an end-loading capability. One spur (S-446) has a bilevel/trilevel ramp. These spurs have a combined capacity of twenty-three 60-foot cars. The surface around the spurs is hard sand and asphalt, and the staging area is good. Since the asphalt street is immediately adjacent to the ramp, tracked vehicles cannot be loaded at these spurs. The track is in excellent condition (figs 29 through 32).

Other usable facilities on this base are the three side-loading ramps along 17th, 18th, and 19th Streets (figs 33 through 35) and two tracks north of 12th Street, which are serviced by a heavy-duty straddle crane (fig 36). Also two portable steel end-loading ramps are available (fig 37). These sites were not considered in the simulation because of expected Marine Corps priority during mobilization. The heavy-duty straddle crane would be most useful for loading tracked vehicles. In the past, Fort Irwin has had some tracked vehicles loaded onto/unloaded from trucks by the crane and has reimbursed the Marine Corps for the service. The vehicles are transported over the highway to and from Fort Irwin. The vehicles are loaded/unloaded at Fort Irwin by motor end-loading ramps. If the Army were permitted to use the heavy duty crane during mobilization, further study of the movement of tracked vehicles to this facility is warranted.

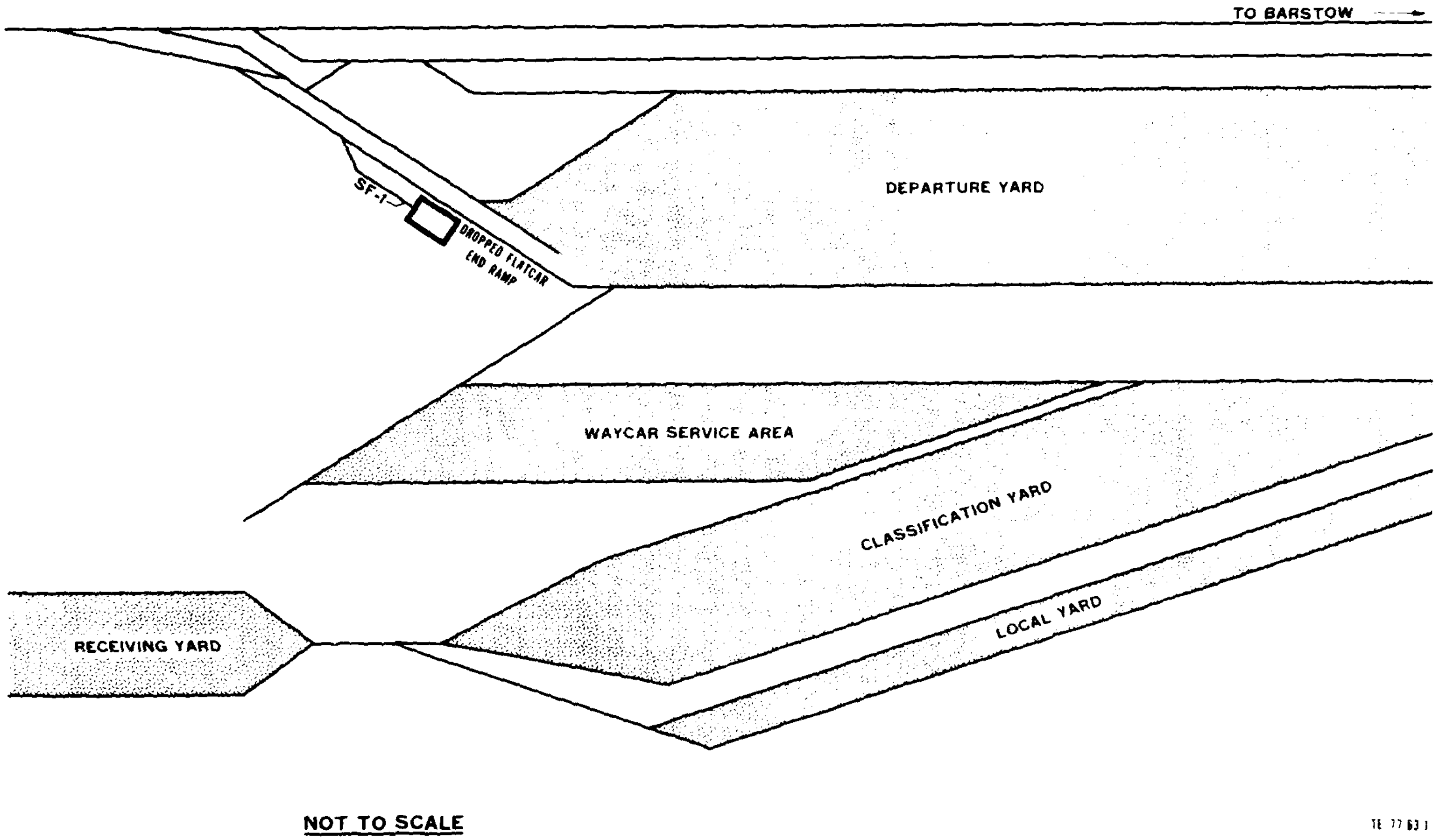

Figure 24. ATSF - new classification yard.

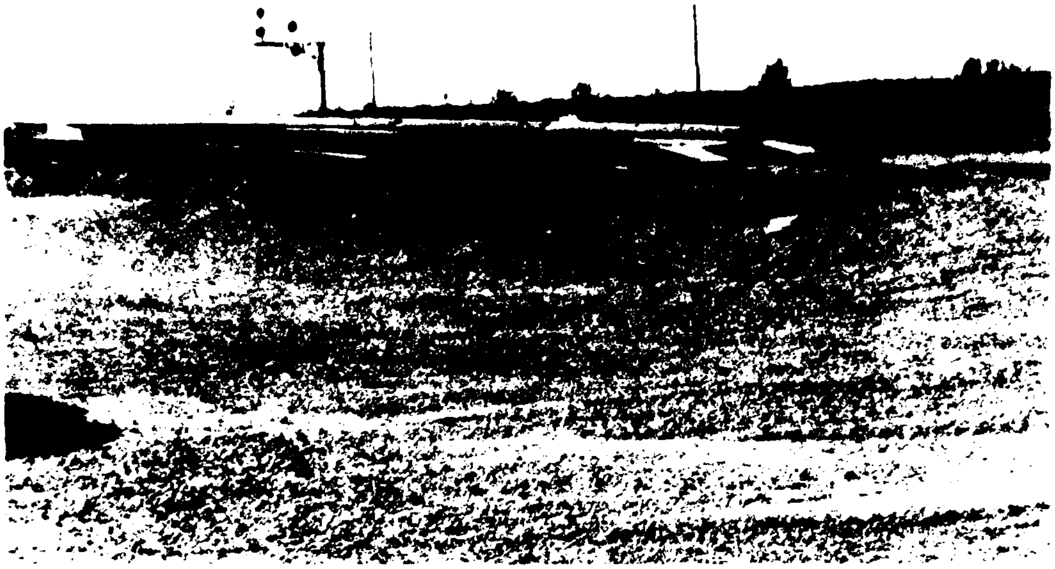

Figure 25. SF-1 with a dropped flatcar serving as a ramp (new yard).

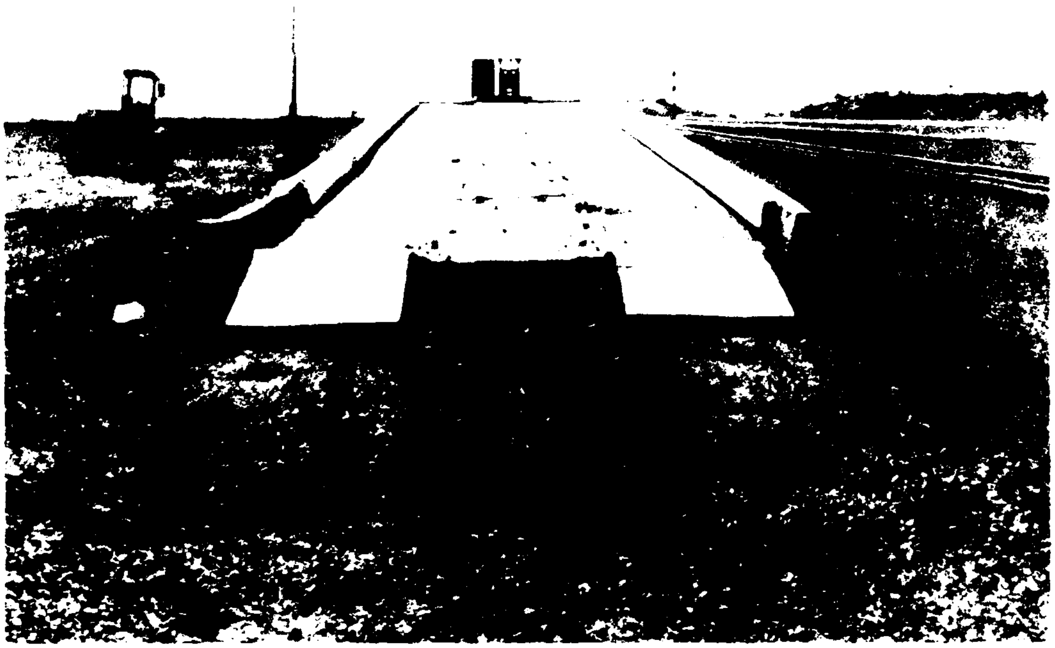

Figure 26. End view of dropped flatcar serving as a ramp.

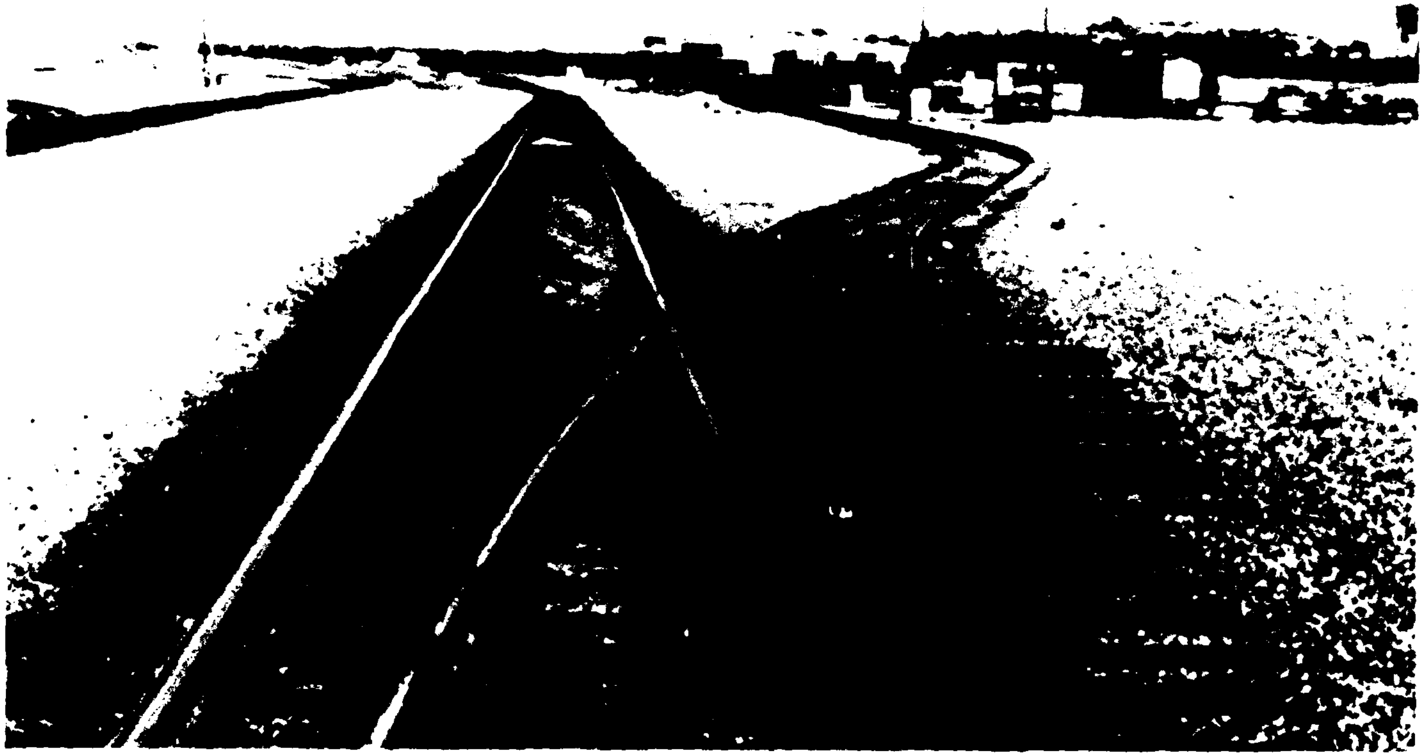

Figure 27. SF-1 spur (new yard) (looking southeast).

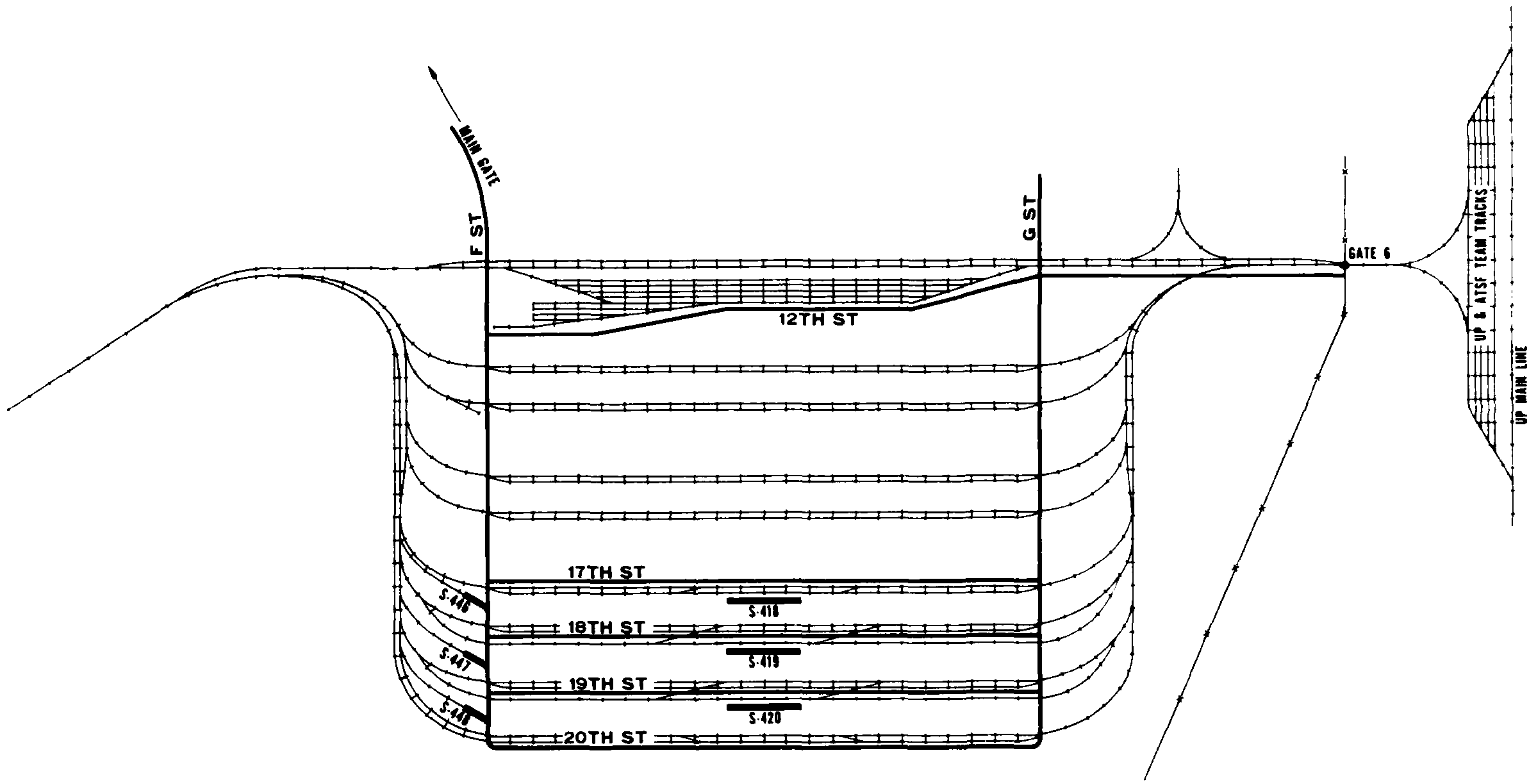

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Figure 28. USMC Yermo site plan.

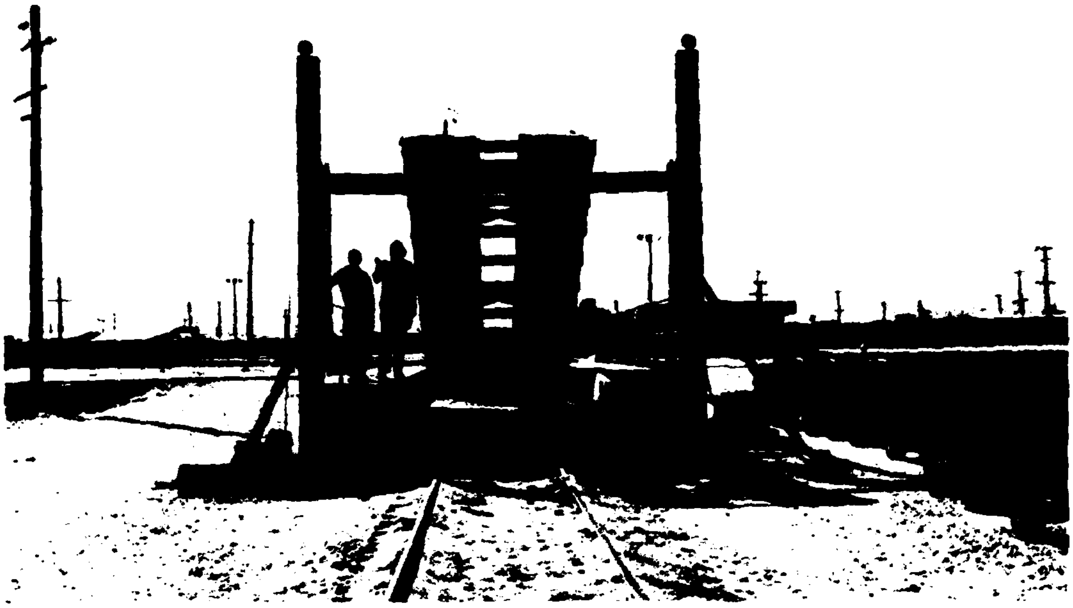


Figure 29. Bilevel ramp at S-446, USMC Yermo
(looking east toward access road).

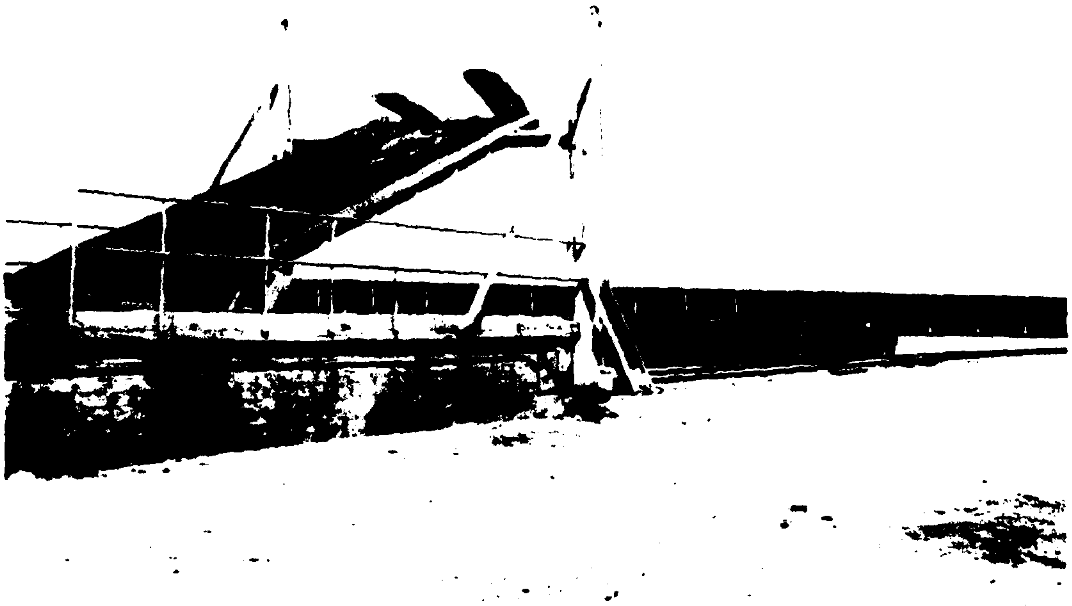


Figure 30. Bilevel ramp at S-446, USMC Yermo
(looking west).

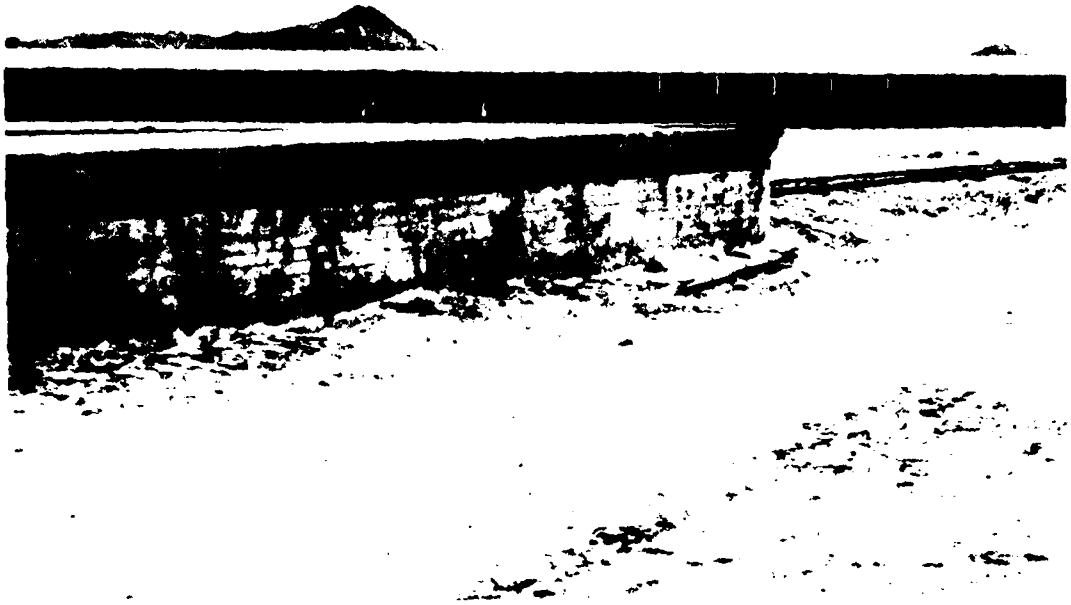


Figure 31. End-loading ramp at S-447, USMC Yermo (looking west).

Figure 32. End-loading ramp at S-448, USMC Yermo (looking west).

Figure 33. Side-loading ramp at 17th Street, USMC Yermo (looking southeast).

Figure 34. Side-loading ramp at 18th Street, USMC Yermo (looking southeast).

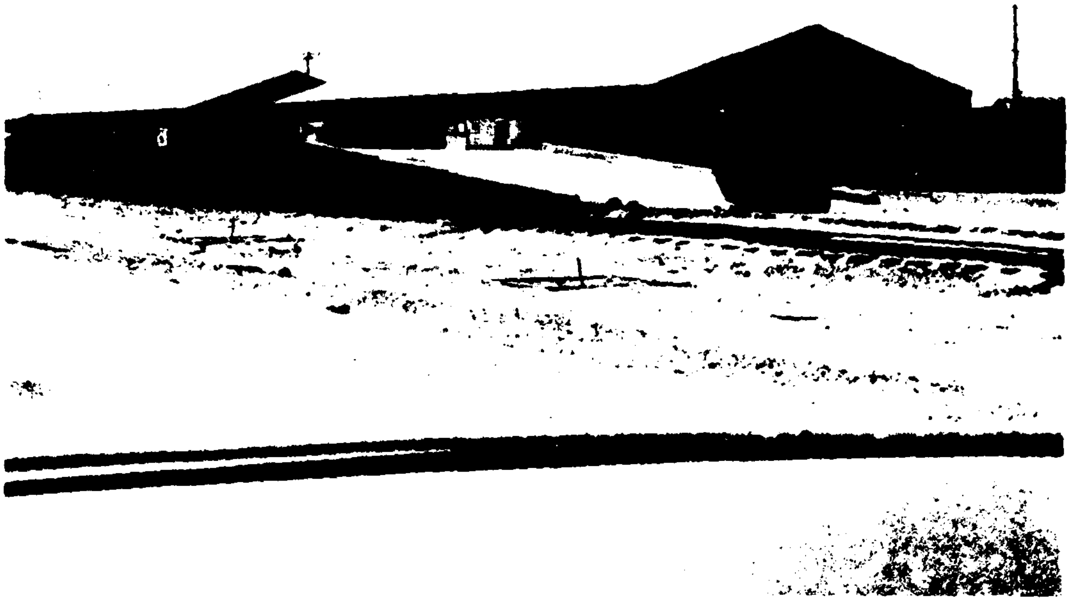


Figure 35. Side-loading ramp at 19th Street, USMC Yermo (looking southeast).

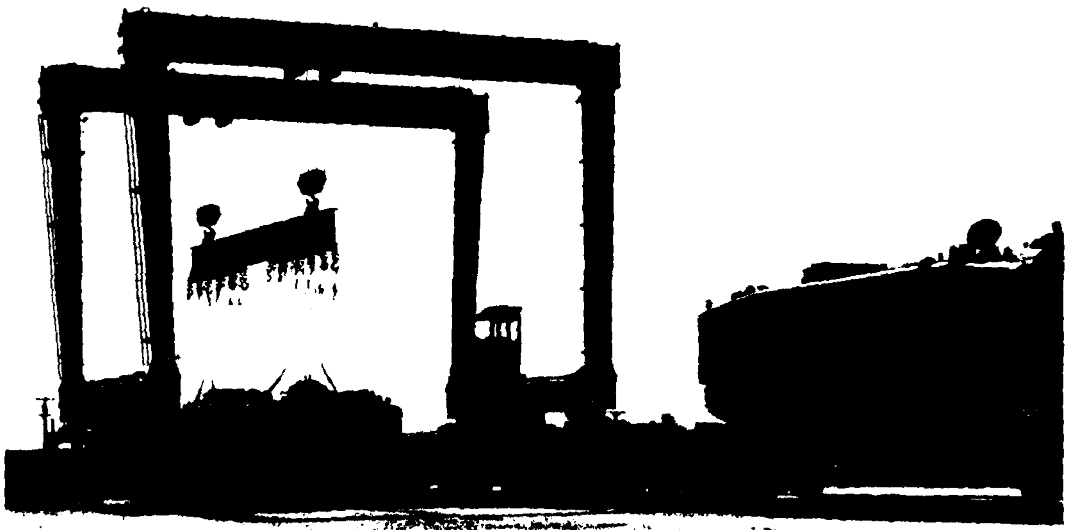


Figure 36. Heavy-duty straddle crane at USMC Yermo.

Figure 37. Portable steel end-loading ramps at USMC Yermo.

5. USMC - Nebo

The USMC Supply Center at Nebo (fig 38) is 5 miles east of Barstow along old Route 66 near Interstate Route 40. About 7 miles of trackage is located on this base. Service to this base is provided by the ATSF Railroad. Two spurs are available for end loading. The capacity of track S-211 is fifteen 60-foot cars. The track is in excellent condition, the staging area is good, and the ramp is concrete (fig 39).

Track S-45 has a capacity of five 60-foot cars, a good staging area, a concrete ramp, and it is in excellent condition, figure 40. Access to Nebo is by old Route 66 near I 40 and a minor road from Marine Corps Yermo. Again, coordination with the Marine Corps is necessary for Army use of this installation in case of mobilization.

6. Atchison, Topeka, and Santa Fe - Hinkley

Hinkley is about 11 miles west of Barstow in the Hinkley Valley and is serviced by ATSF. The site consists of a main line track, a long passing track, and a spur, which is connected at both ends to the passing track. With a portable ramp at one end of the spur, this site has a capacity of sixteen 60-foot cars. A concrete side ramp is adjacent to the main line, but is useless for outloading vehicles. No lighting exists here and the ground is packed sand. The staging area is good and the track is in good condition (figs 41 through 44). Access to this site is excellent, from Barstow

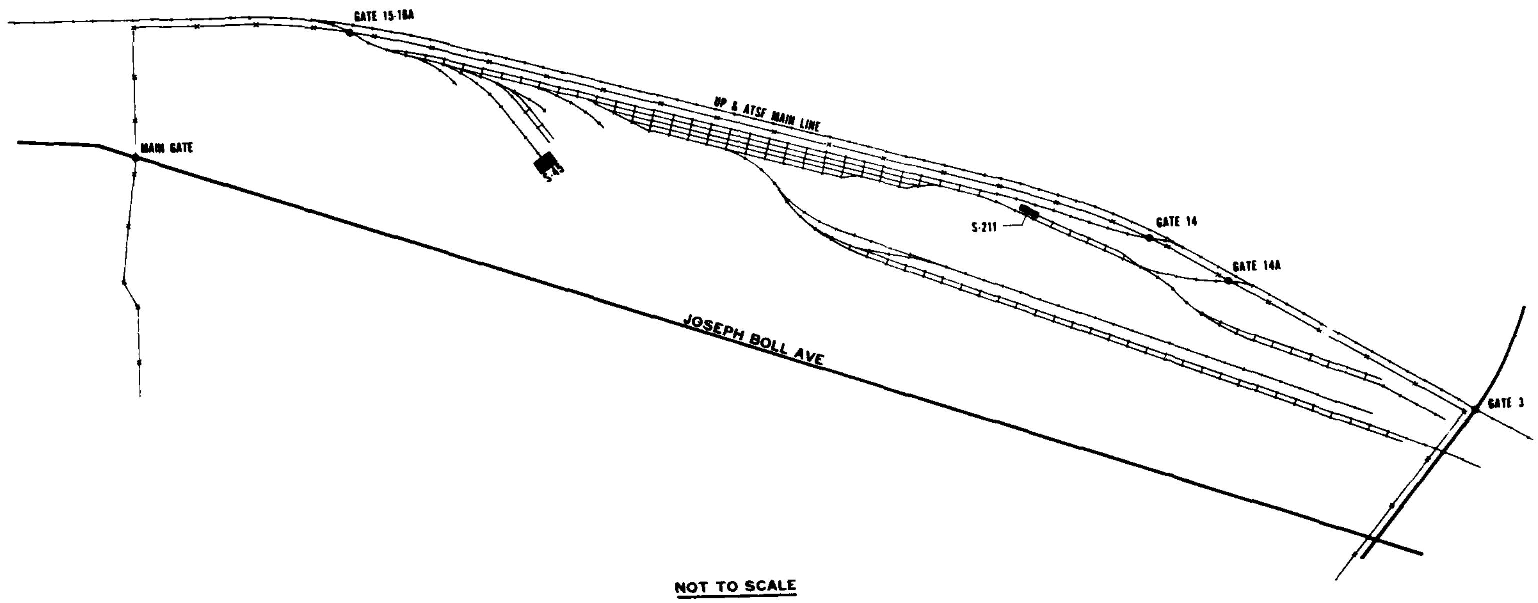


Figure 38. USMC Nebo site plan.

Figure 39. End-loading ramp at S-211, USMC Nebo (looking east).

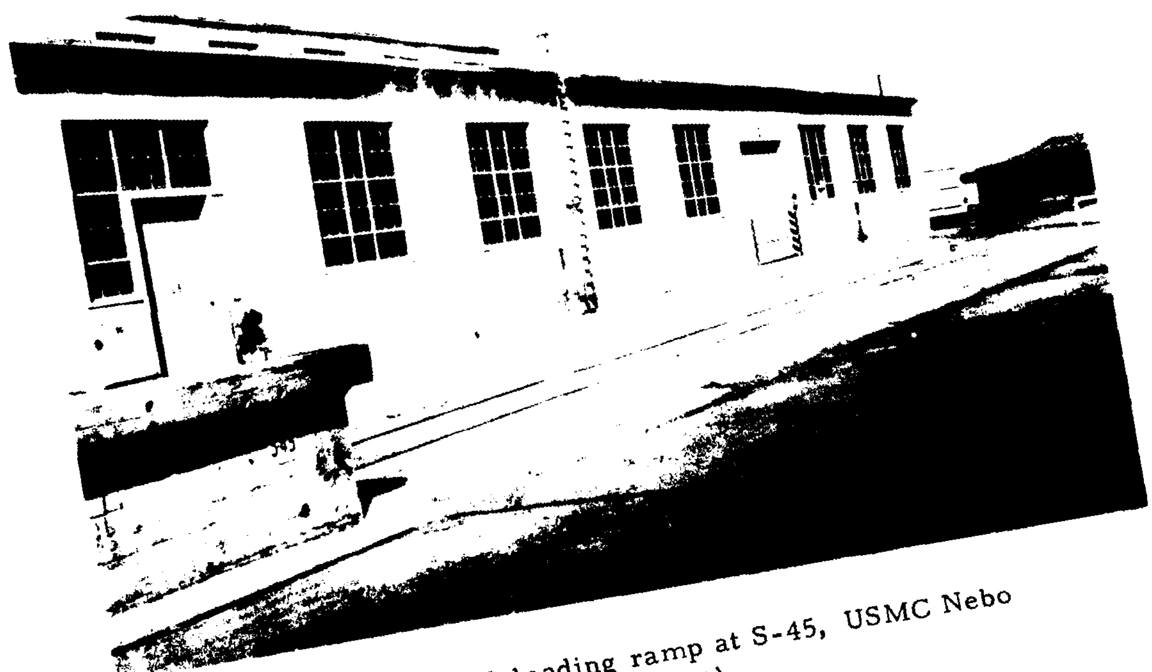


Figure 40. End-loading ramp at S-45, USMC Nebo (looking northwest).

Figure 41. Hinkley spur (looking east).

Figure 42. Hinkley staging area (looking east).

Figure 43. Hinkley side ramp (looking south).

Figure 44. Hinkley (looking north).

along Routes 466 and 58, for wheeled vehicles. Dirt roads lead to this site from the north, and a tank trail probably could be found from Fort Irwin, 37 miles to the northeast.

7. Daggett Airport

Daggett Airport, about 13 miles east of Barstow along old Route 66 in the Mojave Valley, is 15 miles southwest from Manix. Service is provided by the ATSF Railroad. This site consists of two spurs connected to the main line by a winding section of track on the northern side of the airfield. This track splits into two spurs--a northern spur with no ramp and a continuing southern spur with a huge end-/side-loading concrete ramp. These spurs are capable of handling eight and fifteen 60-foot cars, respectively. Of course, a portable ramp would be needed on the northern spur. The surrounding surface is lightly graveled sand. No lighting is available, but the staging area is good. The Government presently leases this site to the Railguard Railcar Repair Company. The track is in excellent condition (figs 45 through 49).

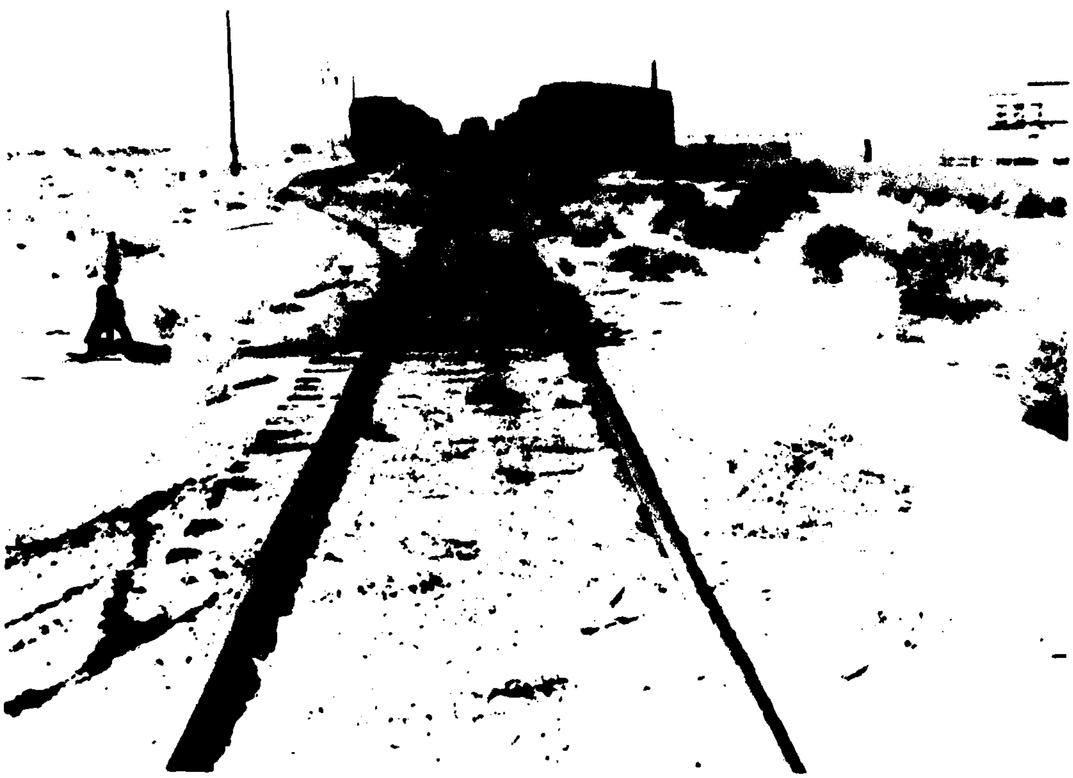


Figure 45. Daggett Airport spur entrance (looking east).

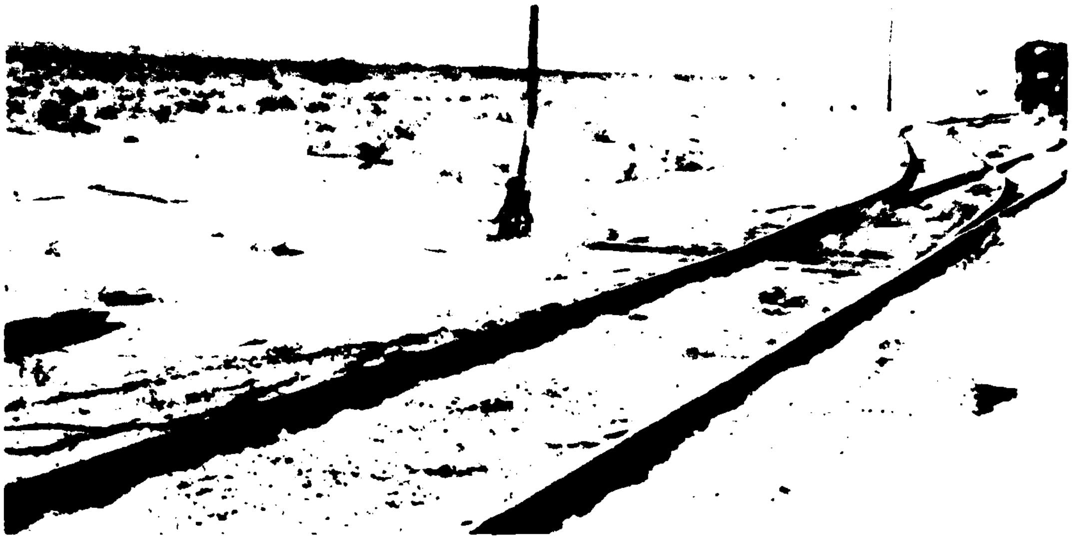


Figure 46. Daggett Airport (looking northeast).

Figure 47. Daggett Airport loading ramp (looking west).

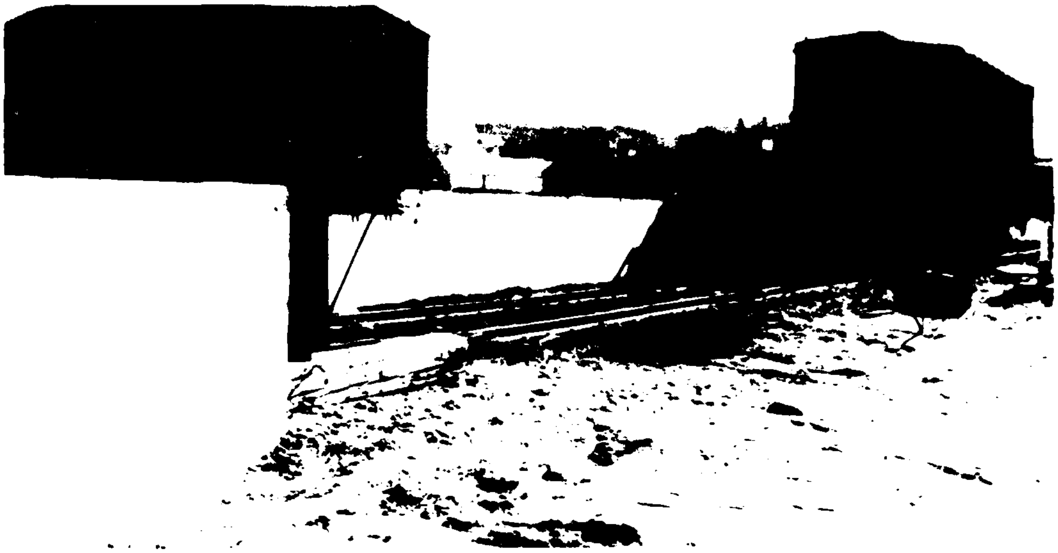


Figure 48. Daggett Airport end- and side-loading ramp.

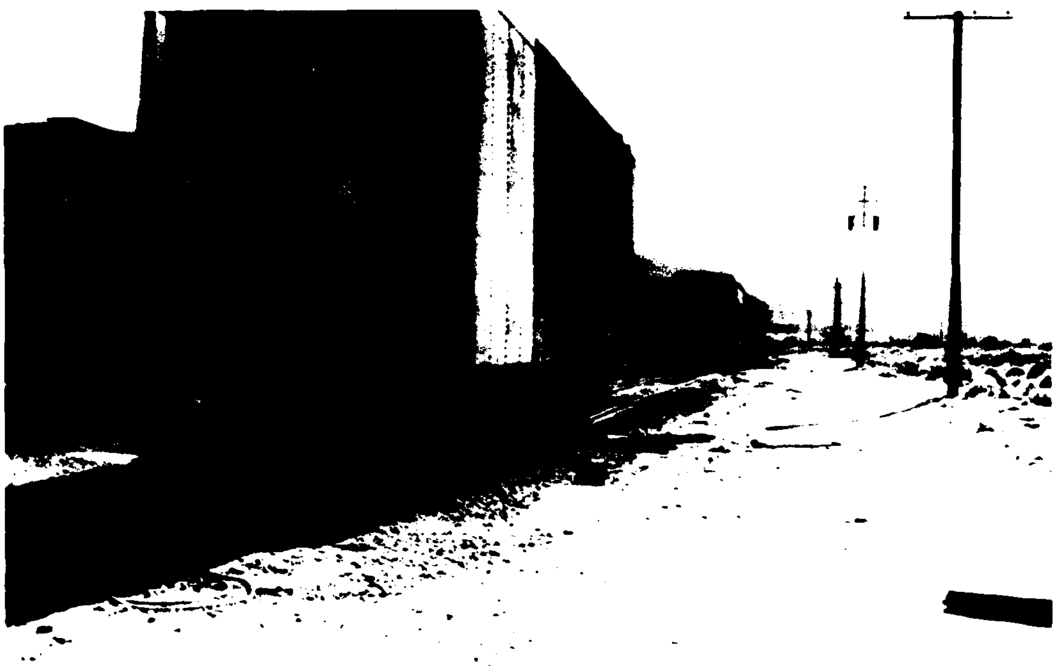


Figure 49. Daggett Airport north spur (looking west).

Access, is by old Route 66 near I 40 from Barstow, or dirt roads to old Route 466 near I 15. In an emergency, the tracked vehicles probably could be driven along dirt roads from Manix to the Daggett Airport. The survey of the leased property, not available to the Army at this time, is included in this report so that the information will be available if the lease expires.

C. CURRENT PROCEDURES

No rail facilities exist within the Fort Irwin boundary. However, Fort Irwin has been using a loading/unloading spur at Manix and a portion of the rail facilities at USMC Supply Center Yermo. Since Fort Irwin has no rail crew or locomotive, Union Pacific Railroad does the switching at Manix, and USMC Supply Center does its own switching. If rail traffic arrives via the ATSF road, switching operations at the team tracks transfer the cars to Union Pacific for delivery to Yermo or Manix. Nonroadable or tracked vehicles are transferred between Fort Irwin and the USMC Supply Center by truck. Tracked vehicles are driven to and from Manix and Fort Irwin via a tank trail across privately owned property leased to the US Army. Outloading plans have not been developed previously for mobilization. In the past, Fort Irwin has had no requirement for large-scale moves. Supplies of handtools, bridgeplates, and blocking and bracing materials are insufficient for a division-size move.

D. RAIL SYSTEM ANALYSIS

1. Current Outloading Capability

Although Fort Irwin has no trackage on post, it does have access to the spur at Manix with a capability of twenty-nine 60-foot railcars, and intermittent use of the straddle crane at USMC Supply Center. The Manix spur has a potential outloading capability of 34 railcars per day for the minimum daylight month of December and 51 railcars per day for the month of June. However, lack of trained personnel, MHE, and blocking and bracing materials limits the current capability to an outloading rate of 10 flatcars per day. Further, the rail system in the Fort Irwin area has a much greater potential capability than current capability. Many spurs or passing tracks in the area can be converted to loading sites simply by adding portable ramps.

2. Rail Outloading Analysis

A complex system structure can be viewed as a series of interconnected subsystems. The limiting subsystem within the system establishes the maximum outloading capability. Therefore, in ascertaining the maximum rail outloading capability at Fort Irwin, the following subsystem separation was used:

a. Commercial Service Capabilities

Commercial service capabilities present no problem to Fort Irwin. The common carriers serving the post are the UP and the ATSF, and their operations in the vicinity of Fort Irwin are well organized. The local railroad agents in the Fort Irwin area are confident that they can fulfill any task required of them, and a survey of the facilities and equipment confirmed their optimism. Railcar storage for empties exists at the ATSF Barstow classification yard.

b. Moving to and Loading on Railcars at a Particular Site

The movement of cargo to loading sites is relatively quick and efficient since most of the equipment is self-propelled and access is along good paved roads. Traffic patterns and traffic control would have to be set up, but such measures should be standard for full-scale outloading operations. Staging areas near the outloading sites are limited, and queuing will block some streets. Recent field tests, during loading operations, revealed that vehicles move along the flatcars at an average speed of 1 mile per hour, with only one vehicle moving on a railcar at any one time. The longest string of empty flatcars used by the recommended outloading plan, assuming 60-foot car lengths (coupler to coupler), was 40 cars, the length of SF-3. Using that figure, the first vehicle would reach the end of the last car 27 minutes after driving up the ramp; then blocking and bracing could be started. Loading time is insignificant in comparison with blocking and bracing time (table 3). Therefore, moving to and loading on the railcars is not the limiting subsystem. However, driving vehicles on flatcars "circus style" depends on the use of bridgeplates to span the gap between the cars. According to the recommended plan employed in our analysis, no fewer than 141 sets of bridgeplates are required for simultaneous loading of 210 60-foot equivalent railcars at four sites.

TABLE 3

TIMES REQUIRED TO PERFORM VARIOUS LOADING FUNCTIONS

	Action	Type Vehicle or Item Being Loaded	How Loaded	Time Required Min-Sec	Considerations
Bilevels	Vehicles Driving on Bilevel Railcars (89-ft long)	Jeep	Own power	1'-00" per Railcar Length	Average of 5 timings
Bilevels	Vehicles Driving on Bilevel Railcars (89-ft long)	1-1/4-Ton Pickup	Own power	1'-03" per Railcar Length	Average of 6 timings
Bilevels	Vehicles Driving on Bilevel Railcars (89-ft long)	Gama Goat	Own power	1'-32" per Railcar Length	Average of 8 timings
Bilevels	Average Total Time to Load, Tiedown Vehicles on Bilevel Railcar, Complete	The three types above plus 3/4-ton trucks, mixed	Own power	34'-00" per Railcar	Average number of Bilevels loaded in string of cars - 15
TOFC's	Truck Tractor Backing Semitrailers on String of 89-ft TOFC Railcars	Semitrailers	Truck tractor	0'-42" per Railcar Length	Average number of TOFC cars in string --11, 2 trailers per car
TOFC's	Average Total Time to Load and Secure Semi-trailer to Hitch on TOFC Railcar	Semitrailers	Truck tractor	10'-00" per Semi-trailer	Average number of TOFC cars in string --11, 2 trailers per car
Flats	2-1/2-Ton Trucks Circus Loading on 60-ft flats	2-1/2-Ton Trucks	Own power	30"-45" per Railcar Length	Average of several timings
Flats	Total Time to Circus Load 11 60-ft Flats With 2-1/2-Ton Trucks, 2 per car (load only)	2-1/2-Ton Trucks	Own power	35'-00" per 11 60-ft Cars	
Forklift	Average Time for Rough Terrain Forklift Truck to Pick Standard-Size Containers (6-ft Wide, 8-ft Long, 5-ft High Approx) off Flatbed Truck, Transit 75 ft, and Load on Rail Flatcar.	Containers	Forklift	2'-12" per Container	Average of loading of 18 containers

c. Blocking, Bracing, and Safety Inspections

Blocking, bracing, and safety inspection times are difficult to project. They depend on a number of variables such as:

(1) Crew size and experience.

(2) Extent of the safety inspection.

(3) Documentation.

(4) Availability of blocking and bracing material and materials-handling equipment (MHE).

During REFORGER 76, the establishment of a 5- to 7-hour time limit for loading, blocking, and bracing at a loading site, as a reasonable goal for crews, was based on experience and actual field tests of circus-style loadings. In addition, discussions with the blocking and bracing instructors at Fort Eustis, Virginia, indicated that, to avoid wasted manhours, there should be no more than eight men per crew, regardless of experience.

d. Interchange of Empty and Loaded Railcars

The existence of several commercial railyards in the area makes it possible to accumulate the number of empty cars required to maintain the operation. The various plans for spotting railcars depend on the type of operation. A place or location must be provided for railcars (1) in empty storage, (2) in loaded storage, and (3) at the loading sites. In general, three balanced or equally divided areas must exist somewhere in the vicinity. If the loading sites double for the loaded storage area, the rail system can be considered to have two balanced areas; that is, the total number of spaces are divided equally between empty storage and the loading sites. This would be the case also if the loaded cars, after being loaded, were stored on the main line track that provides service to the installation. If the empty railcars can be stored at a nearby yard owned by the common carrier and can be delivered to the loading sites each day as needed, then only one area is needed--the loading sites.

e. Summary

Considering all the subsystems, current operating procedures and the lack of bridgeplate supply and small handtools emerge as the primary constraints to any large-scale rail outloading operation at Fort Irwin. Therefore, elimination of the deficiencies in these areas is the major prerequisite for a successful operation. When they have been eliminated, the resultant capability should be compared with movement contingency plans. The level of operation for outloading the division (minus one brigade) is approximately 210 railcars per day.

3. Rail System Outloading Options

In calculating the capabilities of each site, the minimum amount of daylight available was used. This occurs during December when 9 hours 49 minutes of daylight is available. This is usually sufficient time to finish one cycle and start another (table 4). Capabilities were calculated for each site for each of the 12 months (tables 5 through 11). The maximum capability for daylight is 375 railcars per day during the month of June for all six sites and 304 for Plan 4.

TABLE 4
HOURS OF DAYLIGHT FOR EACH MONTH

Month	Sunrise	Sunset	Hrs + Min	Hours
Jan	0708	1711	10:03	10.05
Feb	0647	1742	10:55	10.92
Mar	0611	1808	11:57	11.95
Apr	0528	1832	13:04	13.07
May	0457	1856	13:59	13.98
Jun	0445	1916	14:31	14.52
Jul	0457	1915	14:18	14.30
Aug	0520	1848	13:28	13.47
Sep	0542	1807	12:25	12.42
Oct	0606	1725	11:19	11.32
Nov	0634	1655	10:21	10.35
Dec	0701	1650	9:49	9.82

Note: Data shown on the 15th of each month at 35 degrees N. Latitude

TABLE 5
MONTHLY CAPABILITY OF MANIX

Month	No. of Hrs Daylight at Latitude of 35° N.	No. of Cars/Cycle	No. of Cycles/Day	No. of Cars/Day
Jan	10.05	29	1.22	35
Feb	10.92	29	1.32	38
Mar	11.95	29	1.45	42
Apr	13.07	29	1.58	45
May	13.98	29	1.69	49
Jun	14.52	29	1.76	51
Jul	14.30	29	1.73	50
Aug	13.47	29	1.63	47
Sep	12.42	29	1.51	43
Oct	11.32	29	1.37	39
Nov	10.35	29	1.25	36
Dec	9.82	29	1.19	34
Cycle Length: 8 hrs 15 min (8.25)				

TABLE 6
MONTHLY CAPABILITY OF UNION PACIFIC YERMO

Month	No. of Hrs Daylight at 35 N. Latitude	No. of Cars/Cycle	No. of Cycles/Day	No. of Cars/Day
Jan	10.05	84	1.04	87
Feb	10.92	84	1.13	94
Mar	11.95	84	1.24	103
Apr	13.07	84	1.35	113
May	13.98	84	1.45	121
Jun	14.52	84	1.51	126
Jul	14.30	84	1.48	124
Aug	13.47	84	1.39	117
Sep	12.42	84	1.28	107
Oct	11.32	84	1.17	98
Nov	10.35	84	1.07	89
Dec	9.82	84	1.02	85
Cycle Length: 9 hrs 40 min (9.67)				

TABLE 7

MONTHLY CAPABILITY OF ATSF BARSTOW

Month	No. of Hrs Daylight	No. of Cars/Cycle	No. of Cycles/Day	No. of Cars/Day
Jan	10.05	52	1.06	55
Feb	10.92	52	1.15	59
Mar	11.95	52	1.26	65
Apr	13.07	52	1.38	71
May	13.98	52	1.47	76
Jun	14.52	52	1.53	79
Jul	14.30	52	1.51	78
Aug	13.47	52	1.42	73
Sep	12.42	52	1.31	67
Oct	11.32	52	1.19	61
Nov	10.35	52	1.09	56
Dec	9.82	52	1.04	53
Cycle Length: 9 hrs 30 min (9.5)				

TABLE 8

MONTHLY CAPABILITY OF USMC YERMO

Month	No. of Hrs Daylight	No. of Cars/Cycle	No. of Cycle/Day	No. of Cars/Day
Jan	10.05	23	1.13	25
Feb	10.92	23	1.22	28
Mar	11.95	23	1.34	30
Apr	13.07	23	1.47	33
May	13.98	23	1.57	36
Jun	14.52	23	1.63	37
Jul	14.30	23	1.60	36
Aug	13.47	23	1.51	34
Sep	12.42	23	1.39	32
Oct	11.32	23	1.27	29
Nov	10.35	23	1.16	26
Dec	9.82	23	1.10	25
Cycle Length: 8 hrs 55 min (8.92)				

TABLE 9
MONTHLY CAPABILITY OF USMC NEBO

Month	No. of Hrs Daylight	No. of Cars/Cycle	No. of Cycle/Day	No. of Cars/Day
Jan	10.05	20	1.19	23
Feb	10.92	20	1.29	25
Mar	11.95	20	1.42	28
Apr	13.07	20	1.55	31
May	13.98	20	1.66	33
Jun	14.52	20	1.72	34
Jul	14.30	20	1.70	33
Aug	13.47	20	1.60	31
Sep	12.42	20	1.48	29
Oct	11.32	20	1.34	26
Nov	10.35	20	1.23	24
Dec	9.82	20	1.17	23

Cycle Length: 8 hrs 25 min (8.42)

TABLE 10
MONTHLY CAPABILITY OF ATSF HINKLEY

Month	No. of Hrs Daylight	No. of Cars/Cycle	No. of Cycle/Day	No. of Cars/Day
Jan	10.05	16	1.33	21
Feb	10.92	16	1.44	23
Mar	11.95	16	1.58	25
Apr	13.07	16	1.72	27
May	13.98	16	1.84	29
Jun	14.52	16	1.92	30
Jul	14.30	16	1.89	30
Aug	13.47	16	1.78	28
Sep	12.42	16	1.64	26
Oct	11.32	16	1.49	23
Nov	10.35	16	1.37	21
Dec	9.82	16	1.30	20

Cycle Length: 7 hrs 35 min (7.58)

TABLE 11

MONTHLY CAPABILITY OF DAGGETT AIRPORT

Month	No. of Hrs Daylight	No. of Cars/Cycle	No. of Cycle/Day	No. of Cars/Day
Jan	10.05	23	1.23	28
Feb	10.92	23	1.34	30
Mar	11.95	23	1.46	33
Apr	13.07	23	1.60	36
May	13.98	23	1.71	39
Jun	14.52	23	1.78	40
Jul	14.30	23	1.75	40
Aug	13.47	23	1.65	37
Sep	12.42	23	1.52	34
Oct	11.32	23	1.39	31
Nov	10.35	23	1.27	29
Dec	9.82	23	1.20	27
Cycle Length: 8 hrs 10 min (8.17)				

The various options for outloading plans are shown in figure 50. The recommended plan, Plan 4, uses four main sites--Manix, UP Yermo, ATSF Barstow, and ATSF Hinkley--with a capability of 210 railcars per day. However, ATSF Hinkley is a long distance away for a capacity of only 16 cars. By using these sites, enough capability will be provided for a mobilized movement without losing all centralization, which is necessary for such an operation. For mobilization outloading, the other three sites--USMC at Yermo and Nebo and Daggett Airport--were deemed limited in use. The US Marine Corps Supply Center Yermo and Nebo probably would restrict "outside" use of its facilities. The present potential capability, which produces a minimum of 34 railcars per day for the month of December, reflects the restrictions at the off-post facilities that Fort Irwin uses. Manix is the only site that can be used for tracked vehicles and is adequate for present movements. Fort Irwin also uses the straddle crane at the USMC Supply Center Yermo for other shipments, but does not use the end ramps. The Army pays the USMC on a cost-per-car basis for any loading or unloading done at the USMC Supply Center.

Plan 1, makes full use of Manix and partial use of ATSF's track at the radio tower (SF-3). In all plans Manix is used to its full capability for tracked vehicles. The ATSF spur is excellent for wheeled vehicle movement. This plan produces a minimum of 50 railcars per day for the month of December.

Track Section and Facilities	Railcar Capacity 60-Foot Lengths Coupler to Coupler	Number of Railcars per Day for Minimum Daylight[1]	Item Repair Costs	Day Loading Only					
				Present Potential Capability	Plan 1 50 RCPD	Plan 2 87 RCPD	Plan 3 150 RCPD	Plan 4[2] 210 RCPD	Plan 5 258 RCPD
Manix	29	34 (51)		34	32	32	32	34	34
Union Pacific Yermo	84	85 (126)	$5,000[3]				85	85	85
ATSF Barstow	70	71 (97)			18[4]	55	33[4]	71[5]	71[5]
USMC - Yermo	23	25 (37)							25
USMC - Nebo	20	23 (34)							23
ATSF Hinkley	16	20 (30)	$2,500[3]					20	20
Total Cost					0	0	$5,000	$7,500	$7,500

1/ Number in parenthesis is railcar capability for maximum daylight, which is during the month of June.
2/ Plan 4 is the recommended plan.
3/ Portable timber ramps.
4/ SF-3 only.
5/ Includes boxcars at SF-4.

Figure 50. Rail system outloading options.

Plan 2 makes full use of both Manix and ATSF Barstow for a minimum of 87 railcars per day for the month of December. Union Pacific Yermo could provide more railcars per day than ATSF, but the attractiveness of the ATSF spur at the radio tower gives ATSF the advantage for this plan.

Plan 3 uses all of Manix and Union Pacific Yermo and part of ATSF's spur at the radio tower. This plan produces a minimum of 150 railcars per day for the month of December. The purpose of using all of Union Pacific Yermo is to centralize the operation as much as possible.

Plan 4, makes full use of Manix, Union Pacific Yermo, ATSF Barstow, and ATSF Hinkley. Although this is the mobilization plan, a major shortfall, as in the other plans, is that tracked vehicles can be outloaded only at Manix. An additional spur at Manix would ease this constraint at very little cost to the Army. This plan produces 210 railcars per day for the month of December.

Plan 5 is shown as the maximum outloading plan, using all of the available trackage in the area. For minimum daylight, a total of 258 railcars per day can be outloaded.

4. Analysis of Railcar Requirements

As stated in the directive, the available rail facilities must be capable of outloading a mechanized infantry division (minus one brigade). The railcar requirements for outloading such a unit are summarized in table 12. For purposes of this evaluation, the 4th Infantry Division (Mechanized) was used, as their needs were readily available. All figures were rounded to the next whole number. Finally, the average car length was calculated as shown in table 12 to assess the capability of the available trackage. The average length used was 60 feet for railcars ranging from 48 feet to 85 feet. The total number of cars needed was 1, 218.

All of the 330 railcars of tracked vehicles must be loaded at the Manix siding. At the rate of 34 railcars per day, for Plan 4, the total loading time at Manix is 9. 7 days, which rounds off to 10 days. The remaining 888 railcars to be loaded elsewhere at the rate of 176 railcars per day, according to Plan 4, require a total loading time of 5. 1 days, which rounds off to 6 days. Therefore, the constraint to the division outloading is at the Manix site, which requires about 10 days while the other sites require only 6 days.

TABLE 12
RAILCAR REQUIREMENTS

Type Equipment	57 Feet	60 Feet	85 Feet	48 Feet 80 Ton	54 Feet 100 Ton	50 Feet Box	Total	Percent
Roadable	564	148	95				807	66.3
Nonroadable	8	2	1				11	.9
Tracked	156	40	26	25	83		330	27.1
Other							0	0.0
Misc						66	66	5.4
Ammo						4	4	0.3
Total	728	190	122	25	83	70	1,218	100.0
Percent	59.8	15.6	10.0	2.1	6.8	5.7	100.0	

Average Car Length

Total Length = (728)(57)+(190)(60)+(122)(85)+(25)(48)+(83)(54)+(70)(50)
= 41,496 + 11,400 + 10,370 + 1,200 + 4,482 + 3,500
= 72,448
Avg Length = 72,448/1,218 = 59.5 feet, rounded to 60 feet

Although these data should be used for planning purposes, note that the total outloading time for the division could be reduced if some of the tracked vehicles could be loaded at sites other than Manix. Possibly some of the lighter tracked vehicles, such as the personnel carriers, could be hauled to Barstow and Yermo by truck, which could reduce the time at Manix by 2 to 3 days, depending on the number of available trucks.

5. Physical Improvements and Additions

Items listed below are all minimum requirements to achieve the recommended outloading rate of 210 railcars per 24-hour day, using existing trackage.

a. Blocking and bracing material needed to supplement the post organic supply for handling all equipment when a mobilization deployment of equipment is required.

b. Bridgeplates for volume outloading of vehicles at all sites except Manix.

c. Sufficient small tools, including power saws, cable cutters, wrecking bars, cable tensioning devices, hammers, and so forth, to permit operation of blocking and bracing crews at all outloading sites.

d. Three heavy timber, portable end-loading ramps should be constructed for loading vehicles at Yermo and Hinkley.

6. Discussion of Time and Costs

a. Physical Improvements

No times were given for projected completion dates on any improvements, but it should be noted that a full division could be in a poor contingency situation at Fort Irwin for some time without the capability to move in an acceptable time frame. The ramps and bridgeplates should be constructed immediately, with a 1-year target recommended for completion of all work. The Manix spur is in good condition and needs no repair now or in the near future. All the other track is commercially owned and the Army cannot dictate repair or maintenance. However, all of the track enumerated in the report was in usable condition.

If a rail line were to be built from Manix to Fort Irwin, the loading spurs should be located behind the motor pool (figs 51 through 53).

Figure 51. North of Fort Irwin motor pool (looking west).

Figure 52. North of Fort Irwin (looking southeast).

Figure 53. North of Fort Irwin compound (looking northeast).

b. Load Time Versus Equipment Type

Two basic types of outloading operations are mobilization and administrative. Mobilization moves are not artificial; since they occur only in times of national emergencies, there is genuine urgency. The most rapid method of loading and securing mobile equipment on railcars is circus style. For example, if unit integrity is to be maintained, 2-1/2-ton trucks that are to pull trailers drive onto the string of railcars towing their trailers, and the equipment is secured in this configuration. This procedure is fast but railcar space is wasted. During actual field tests on standard-type railcars, the loading, securing, and inspection of 2-1/2-ton trucks, two per railcar, site times varied from 5 hours for flatcars with chain tiedowns to 6-1/2 hours for flatcars without chain tiedowns (fig 54). This was a fast, efficient operation.

Figure 54. Circus-style loading of 2-1/2-ton trucks, total loading, blocking and bracing, and inspection time, 5 hours.

Other similar operations that could occur in a mobilization-type move, for most Army units, include loading various sizes of containers on standard-type flatcars by using forklifts. This operation, including loading, securing, and so forth, was accomplished in 5-1/2 hours. Site loading and securing times for semitrailers and vans on TOFC cars averaged 4 hours. All things considered, the circus-style loading operations indicate that, for mobilization moves, the loading, blocking and bracing, and inspections can be accomplished within 7 hours for most types of equipment (table 13).

For an administrative-type move, plenty of time exists for planning; night operations are unnecessary except to finish work that is not completed during daylight hours and to switch railcars. This added flexibility helps to solve unforeseeable problems. The administrative-type move allows time for accumulating special-type railcars, such as bilevel autoracks and TOFC and COFC cars, which significantly reduce both labor and costs. For instance, small vehicles, jeeps, 3/4-ton trucks, 1-1/4-ton trucks, and gama goats can be loaded on bilevel cars (fig 55); semitrailers and vans can be loaded on TOFC cars; and MILVANs, for which there are no chassis, can be loaded on COFC cars. Mobile equipment, some 2-1/2-ton trucks, and all smaller vehicles can be loaded on bilevel railcars. These three types of specific railcars require no blocking and bracing except that integral to the car.

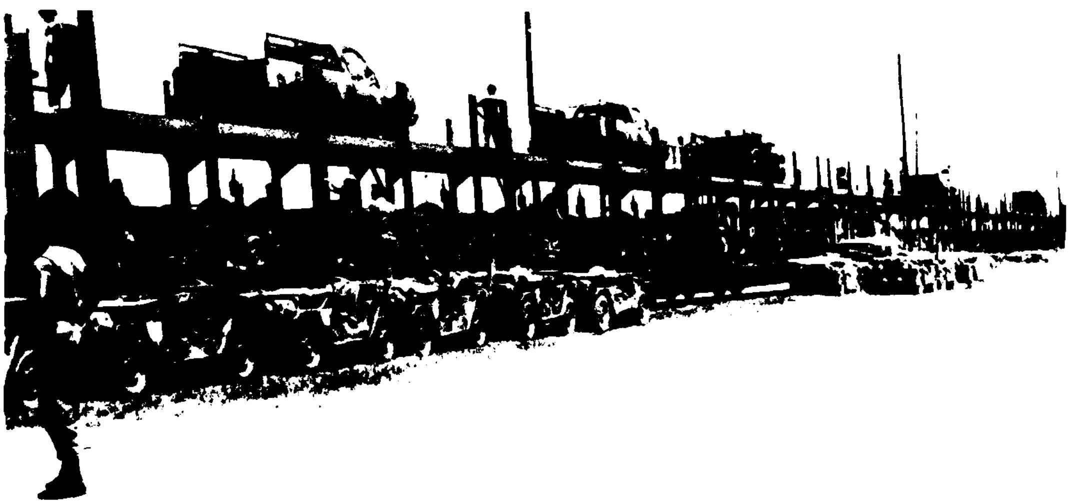


Figure 55. Lower level of bilevel cars loaded with jeeps, gama goats, 3/4-ton trucks, and 1-1/4-ton trucks.

TABLE 13

TYPICAL SITE LOADING AND BLOCKING AND

LEGEND

Type Railcar

B1 - Bilevel

TOFC - Trailer on flatcar

COFC - Container on Flatcar

DF - Flatcar/Integral Cha

F - Standard-Type Flatca

Type Railcar	Average Number Loaded (Range)	Type Load	How Loaded	Total Site Time Required (hrs) and Other Considerations	Details on T
B1 89 ft	16 15-17	C	End, own power	7.5 All cars had chain tiedowns. Cars did not have bridge PL's, wooden PL's used	Typical Load: 50 jeeps, 6-1¼ ton, 14 Gama Goats, number vehicles - 170
B1 89 ft	14½ 11-18	C	End, own power	10.7 All cars did not have chain tiedowns, used wooden bridge PL's.	Typical Load: 50 jeeps, 6-1¼ ton, 14 Gama Goats, number vehicles - 170
TOFC 89 ft	12 10-12	C	End, backed on by tractor	4.0	Semitrailers - mostly MIL to form 40-ft semis. So military vans on semis.
DF 60 ft	11 9-14	C	End, own power	5.1 Chain tiedowns on all cars, wood wheel chocks, lateral wood blocking at wheels	All 2-1/2-ton trucks, var per railcar.
F 54 ft	10	C	End, own power	6.5 Cable tiedowns made at site. Wheel chocks, lateral wheel blocking	All 2-1/2-ton trucks, var per railcar.
F 54 ft	10 9-10	A	End, own power. Some forklift	10.0 Cable tiedowns made at site. Wood blocking as required.	1/4-ton trailers Wreckers Forklifts Mules, jeeps, CONEX conta
F 54 ft	9	A	Forklift, manpower	10.8 Cable tiedowns made at site. Wood blocking as required.	All 1/4-ton trailers or h of similar small items.
DF 60 ft	10 8-13	A	Rough terrain forklifts	8.3 Chain tiedowns on all cars. Wheel blocking used also	All two-wheeled trailers pulled by 2-1/2-ton truck 5 trailers/railcar
F 54 ft	9	A	Rough terrain forklifts	5.5 Cable tiedowns made at site. Blocking as required.	All containers - 5 cars with 8 containers 3 cars with 4 containers 1 car with 10 containers

TABLE 13

BLOCKING AND BRACING TIMES (TOTAL)

Integral Chain Tiedowns

-Type Flatcar

Type Load

A - Administrative

C - Circus

S - Semitrailers

Details on Type Load	Manpower	Typical Problems
: 50 jeeps, 15-3/4-ton trucks, Gama Goats, each level, total les - 170	1½-2 men per vehicle	No bridge PL's on cars had to use wooden PL's. Man has to walk to front of vehicle as guide and to straighten bridge PL's. Delays if all vehicles not at site at loading time.
: 50 jeeps, 15-3/4-ton trucks, Gama Goats, each level, total les - 170	1½-2 men per vehicle	Same as above; and, missing tiedowns; cable tiedowns had to be fabricated and used. (Storm, rain not included in total time)
- mostly MILVAN married together t semis. Some 20-ft semis and on semis. Two per TOFC car.	6-8 man crew	Some older cars have trailer hitches which have to be "pulled-up" into position by a cable attached to the tractor.
n trucks, various kinds, two	10 men per railcar	None
n trucks, various kinds, two	10 men per railcar	None
lers , CONEX containers	10 men per railcar	Improper installation of tiedowns and blocking. Large number of small items, 1/4-ton trailer slow the installation of blocking since work has to proceed from one end of railcar to the other.
trailers or high percentage mall items.	10 men per railcar	Improper installation of tiedowns and blocking. Large number of small items, 1/4-ton trailer slow the installation of blocking since work has to proceed from one end of railcar to the other.
led trailers (various types 1/2-ton trucks) ailcar	10 men per railcar	None noted
rs - 8 containers each. 4 containers each. 0 containers each.	10 men per railcar	None noted

2

Loading and securing times for bilevels varied from an average of 7-1/2 hours for a string of cars that were fully equipped with chain tiedowns, to 10-3/4 hours for those where cable tiedowns had to be fabricated to replace missing chain tiedowns. The average total time for TOFC cars was 4 hours. Administrative-type loads, which require relatively longer times and effort, are illustrated in figures 56 and 57. This type of load required a total site time of 10 to 11 hours. In general, administrative-type operations should be planned for daylight hours, leaving night hours available for finishing up sites that started late or were slowed by problems and railcar switching. This type of planning allows enough flexibility to resolve problems and complete the operation on schedule.

Figure 56. Administrative load, mules.

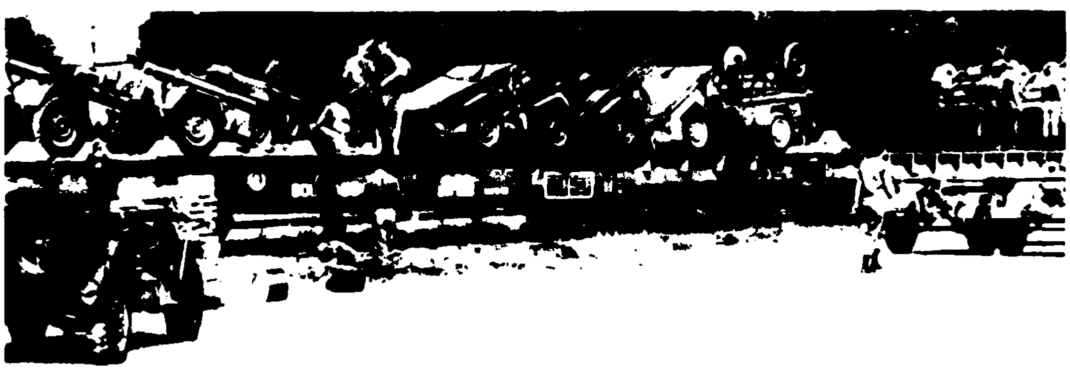


Figure 57. Administrative load, 1/4-ton trailers.

For mobilization-type moves, site time to load and secure equipment on a string of railcars should be accomplished in an average of 7 hours, and for administrative-type moves, 4 to 11 hours. The time/motion studies conducted during the REFORGER 76 exercise resulted in the accumulation of valuable information for planning future station outloading operations and is included in tables 3 and 13. Note that loading times are relatively minor as compared with times required to secure the equipment. As an example, a jeep can drive across an 89-foot-long bilevel car in 1 minute, and a forklift truck can load a container in 2 minutes 12 seconds. So, loading times are not the problem. Also, as soon as the first vehicle is in position, several simultaneous operations are in effect -- loading, blocking, and tieing down. Thus for future planning, site times, not loading times, should be used; as a general rule, 7 hours for a mobilization move, and 4 to 11 hours for an administrative move. The site time of 7 hours for the mobilization move is based on the assumption that only standard-type railcars are available. The minimum of 4 hours for the administrative move results because time is included to plan and assemble the most appropriate type of railcars for the equipment to be moved. The 4 hours in this case was the average time required to load and secure semitrailers and vans on a string of twelve 89-foot TOFC cars. To minimize the number of faulty or unacceptable loads that have to be done over, inspection of the loaded cars by the railroad inspector should proceed simultaneously with the work.

c. Transportation Equipment Costs - Bilevel Railcars Versus 54-Foot Standard Flatcars

A cost comparison of nine different types of equipment to be outloaded in the REFORGER 77 exercise revealed that $129,431 in transportation and materials (timber, cable, and so forth) could be saved by shipping this equipment on bilevel railcars rather than on standard-type, 54-foot flatcars. The equipment items vary from 1/4-ton trailers to 2-1/2-ton trucks and total 623 vehicles, which could be transported on 55 bilevel railcars, see table 14 for details, and appendix C for more information on special-purpose railcars.

COST COMPAR

Column Number	1	2	3	4	5
Item No.	Vehicle Type	Model Number	Weight (lbs)	Height (in.)	Length (in.)
1	2-1/2-Ton Truck	M35A2	13,360	80.8	264.8
2	Gama Goat, 1-1/4-Ton	M561	7,480	71.9	231.1
3	M105A2 1-1/2-Ton Trailer	M105A2	2,670	82.0	166.0
4	1/4-Ton Trailer	M416	580	44.0	108.5
5	400-Gal Water Trailer	M149A1	2,530	80.6	161.4
6	1-1/4-Ton Truck	M880	4,695	73.5	218.5
7	3/4-Ton Trailer	M101	1,350	50.0	147.0
8	1/4-Ton Truck	M151	2,350	52.5	131.5
9	1-1/4-Ton Como Truck	M884	4,648	67.5	218.5
	Total				

<u>SUMMARY</u>

Total cost to ship the 9 different items (623 vehicles) by 54-foot-long standa
Total cost to ship the 9 different items (623 vehicles) by 89-foot-long bileve
Savings in transportation costs if shipped by bilevel flats (Column 10-- Colu
Additional costs of blocking and bracing materials if shipped by 54-foot stand
Total savings if these nine items shipped by bilevel versus 54-foot flatcar

TABLE 14

COST COMPARISON, BILEVELS VERSUS 54-FOOT FLATCARS

5 Length (in.)	6 Quantity to be Shipped	7 Quantity on 50-ft Railcar	8 Dollars	9 No. of 54-ft Cars Required	10 (8 x 9) Trans Cost for Item	11 Quantity on 89-ft Bilevel	12 Dollars	13 No. of Bilevels Required
264.8	110	2	2,413	55	132,715	6	7,238	18
231.1	27	2	2,167	13	28,171	8	5,402	4
166.0	113	3	2,167	37	80,179	12	3,612	9
108.5	136	10	2,167	14	30,338	36	3,612	4
161.4	20	4	2,167	5	10,835	12	3,612	2
218.5	11	2	2,167	5	10,835	8	3,612	2
147.0	8	4	2,167	2	4,334	12	3,612	1
131.5	180	7	2,167	25	54,175	14	3,612	13
218.5	18	2	2,167	9	19,503	8	3,612	2
	623				371,085			55

-long standard flatcars, Column 10	$371,085	
-long bilevel flatcars, Column 14	279,034	
n 10-- Column 14)	$ 92,051	
4-foot standard flatcars	37,380	($60 x 623)
t flatcar	$129,431	

2

of els red	14 (12 x 13) Trans Cost for Item
	130,284
	21,608
	32,508
	25,284
	7,224
	7,224
	3,612
	46,956
	4,334
	279,034

3

III. ANALYSIS OF MOTOR OUTLOADING CAPABILITY AT FORT IRWIN

A. GENERAL

The roadway system on the installation can accommodate the largest highway vehicles. Access to I 15 from Fort Irwin is by a two-lane paved road, which is 40 miles distant. Neither access to the highway system nor the system itself restrains motor outloading capability or movement of roadable military vehicles. However, some of the non-roadable equipment is outsize or overweight for regular highway travel, and a special permit must be obtained.

B. LOADING RAMPS

A survey of the motor pool and other activities likely to have suitable end-loading ramps revealed that only four ramps exist (table 15 and fig 58). Ramp 1 (fig 59) is a concrete top on wooden pilings located off 5th Street by Building 614. The others are all concrete and are located as shown in figures 61 through 63. The surface conditions, staging areas, and access to all of these ramps are excellent.

C. SEMITRAILER OUTLOADING

The loading procedure could be as follows: A vehicle is driven up the ramp onto the waiting semitrailer and temporary chocks are placed. After the loaded semitrailer has been driven slowly from the ramp to a designated location where the loaded vehicle can be secured with tie-down chains, the next semitrailer is backed up to the ramp, and the procedure is repeated.

This procedure does not tie up the ramp while loaded vehicles are being secured. Using a conservative 60 minutes for cycle, one semi-trailer could be loaded per hour per ramp, or 10 vehicles per ramp

TABLE 15
FORT IRWIN MOTOR END-LOADING RAMPS

Ramp and Figure Number	Location	Type of Ramp	Surface Condition	Staging	Access
1 Figure 59	Alongside of Bldg 614 within fenced area	Concrete top on wood pilings	Paved access and dirt staging area	Excellent	Excellent
2 Figure 60	North of 5th St outside fenced area	Concrete	Excellent asphalt	Excellent	Excellent
3 Figure 61	Within storage lot along Ave H	Concrete	Excellent asphalt	Excellent	Excellent
4 Figures 62 and 63	Southeast corner of post cantonment area	Concrete	Excellent asphalt	Excellent	Excellent

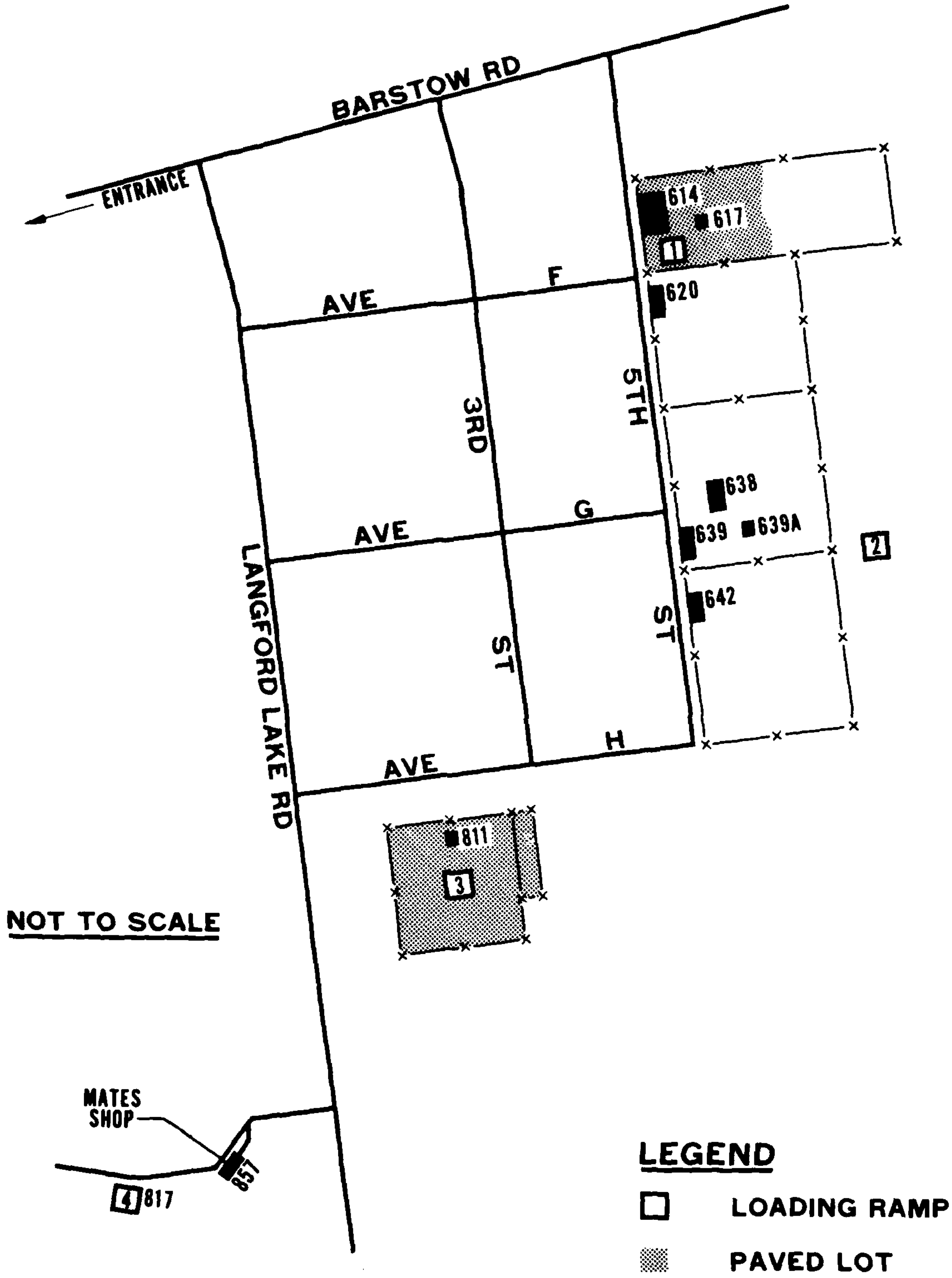


Figure 58. Fort Irwin site plan.

Figure 59. Ramp 1 (looking northwest).

Figure 60. Ramp 2, north of Fort Irwin compound (looking north).

Figure 61. Ramp 3, inside motor pool (looking northeast).

Figure 62. Ramp 4 (looking northwest).

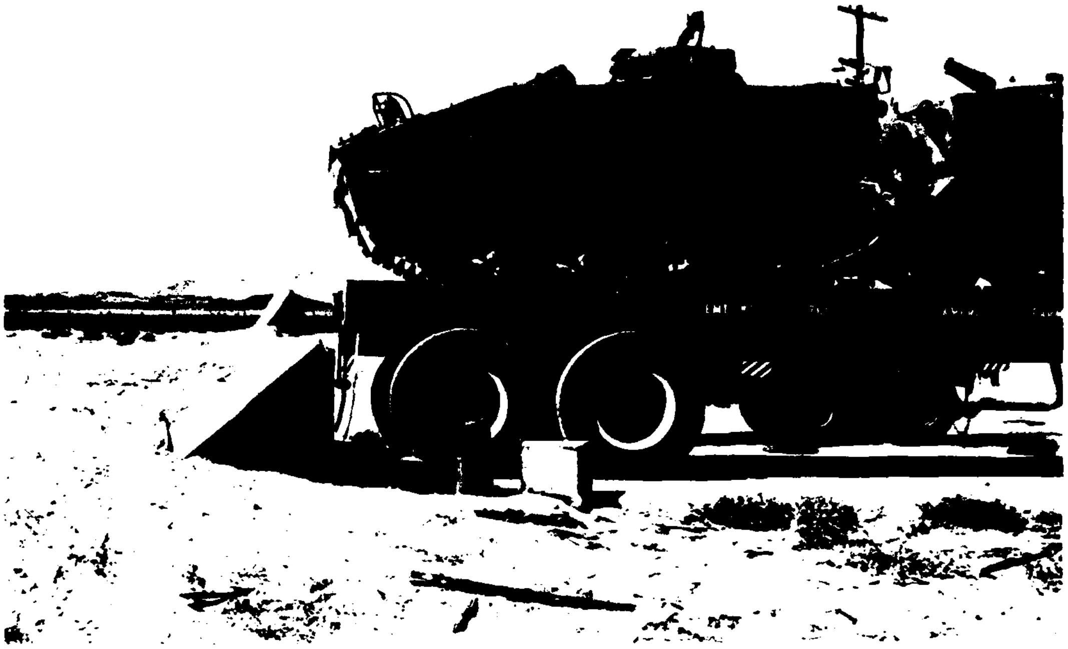


Figure 63. Ramp 4 (looking southwest).

per 10-hour shift. The four existing ramps could produce 40 loads in a 10-hour shift, or 96 per 24-hour day, if sufficient lighting were available for night shifts. (Should night operations be required, tie-down operations could be accomplished in a well-lighted area, such as the baseball or football stadium.) Thus, the present potential capability is 96 semitrailer loads per 24-hour day using the four existing ramps.

Totals of 40 and 96 semitrailer loads per day are not particularly significant for several reasons. First, portable ramps are easily constructed. Timber is the common construction material, but field expedients, such as ditches that trucks can back into for outloading equipment, are very quickly made. Second, semitrailer loading, other than vehicles, is dependent primarily on the amount and capability of materials-handling equipment (MHE). At Fort Irwin, a limited amount of MHE is on hand. Finally, the overriding reason that the motor systems outloading capability figure is not considered particularly significant is that it really is not needed for major outloading actions. Fort Irwin's most likely POE, if the division were deployed to the Pacific theater, is Los Angeles, which is within driving distance of roadable equipment. Fort Irwin's unit is an infantry mechanized division with primarily roadable equipment. The remaining nonroadable equipment can be outloaded by motor or rail at or near Fort Irwin without difficulty. Any movement of roadable equipment farther than Los Angeles--to the gulf coast, for instance--would necessarily be by rail. Therefore, the limited motor systems outloading capability that exists is adequate for current and probable requirements.

D. CURRENT AND MOBILIZATION CAPABILITY

The potential daily capability is 32 semitrailers per 8-hour day; however, due to the nonavailability of commercial trucks, and the shortage of MHE and trained personnel, the daily current capability is limited to about 10 semitrailers per day. Table 16 show the total commercial inventory of trailers for the Barstow area. The daily mobilization capability is 96 semitrailers per 24-hour day.

TABLE 16
INVENTORY OF COMMERCIAL SEMITRAILERS IN THE VICINITY OF FORT IRWIN

Company	Number of Semitrailers	
	Heavy (More than 100,000 pounds)	Light and Miscellaneous
Daggett - Price Transport 36588 Santa Fe Drive Daggett, CA	0	2
Barstow - Victorville Truck Line 1550 State Street Barstow, CA	0	0*

*The present inventory is 0, but with a 24-hour notice, can obtain 100 from Los Angeles.

IV. SPECIAL EQUIPMENT FOR EXPEDITING THE OUTLOADING OF MILVANS

A large supply of trailer-on-flatcar railcars is usually in the system, and container-on-flatcar railcars may be available. These cars should be used to transport semitrailers and MILVANs. If COFC or TOFC flatcars are not available, some blocking and bracing time and expense can be saved by using bulkhead flatcars for transporting MILVANs. See appendix C for additional information.

V. CONCLUSIONS

1. All trackage in the vicinity of Fort Irwin is in generally good condition and usable; however, some ramp construction is required. Current rail outloading capability is limited not by trackage but by lack of trained personnel. The mobilization rail outloading is limited by insufficient end-loading ramps, blocking and bracing materials, bridgeplates, and small handtools, and by lack of outloading plans.

2. Ample trackage exists in the area to outload the division (minus one brigade) in 10 days. The recommended outloading plan, Plan 4, produces a rate of 210 railcars per day.

3. The ATSF and UP classification yards should be used to classify incoming empty railcars destined for Fort Irwin's use, as to type, length, height, and position in string, before movement to loading sites.

4. The ATSF and UP representatives did not express any reservations regarding the outloading of Fort Irwin units concurrently with other local commercial demands.

5. For administrative-type moves, when leadtime is plentiful and costs must be considered, special-purpose railcars (such as bilevel autoracks, TOFC, and COFC cars) are more cost-effective than the standard types and should be used.

6. For mobilization moves, when time is more critical than costs, the use of special-purpose railcars may not be possible because of the short notice and the relatively short supply of these high-demand cars.

7. Estimated minimal cost for portable timber ramp construction, to achieve the 210 daily rate, is $7,500. Costs for bridgeplates, blocking and bracing materials, and small handtools are additional.

8. Capability of motor outloading facilities at Fort Irwin for loading commercial flatbed semitrailers exceeds the probable available supply of trailers for both current and mobilization capabilities.

9. Tracked vehicle movements are restricted to Manix, which limits outloading capability, except for a very small number that could be truck- to a railhead.

10. Support from the USMC Supply Center at Yermo and Nebo would be questionable in case of mobilization.

VI. RECOMMENDATIONS

1. Undertake those items listed in section II, paragraph D5, "Physical Improvements and Additions." These improvements will produce a rail outloading capability of 210 railcars per day and will insure a continued effective rail system.

2. Prepare a detailed unit outloading plan, using the simulation in appendix A as an example, that specifies unit assignments at loadout sites and movement functions.

3. Provide advance training for blocking and bracing crews.

4. Coordinate with the ATSF and UP as early as practicable for the placement of temporary ramps on their trackage and for the order of 1,218 railcars in the event of mobilization.

5. Begin weighing equipment to be outloaded several days before actual outloading begins.

6. Use special-purpose railcars (such as bilevel autoracks for small vehicles, TOFC cars for semitrailers and vans, and COFC cars for MILVANs) for administrative-type moves and, as available, for mobilization moves.

7. Keep abreast of ATSF and UP railroads' plans regarding the selected sites for outloading, as these tracks are essential for the support of a major outloading.

8. Investigate potential trails for driving tracked vehicles to other sites, particularly UP Yermo and Daggett Airport. This will also involve property leasing from, and environmental effects on, the nearby communities.

APPENDIX A

TRACK SAFETY STANDARDS *

PART 213—TRACK SAFETY STANDARDS

AUTHORITY: The provisions of this Part 213 issued under sections 202 and 209, 84 Stat. 971, 975; 45 U.S.C. 431 and 438 and § 1.49(n) of the Regulations of the Office of the Secretary of Transportation; 49 CFR 1.49(n).

SOURCE: The provisions of this Part 213 appear at 36 F.R. 20336, Oct. 20, 1971, unless otherwise noted.

Subpart A—General

§ 213.1 Scope of part.

This part prescribes initial minimum safety requirements for railroad track

*Extracted from Title 49, Transportation, Parts 200 to 999, pp 8-19, Code of Federal Regulations, 1973.

that is part of the general railroad system of transportation. The requirements prescribed in this part apply to specific track conditions existing in isolation. Therefore, a combination of track conditions, none of which individually amounts to a deviation from the requirements in this part, may require remedial action to provide for safe operations over that track.

§ 213.3 **Application.**

(a) Except as provided in paragraphs (b) and (c) of this section, this part applies to all standard gage track in the general railroad system of transportation.

(b) This part does not apply to track—

(1) Located inside an installation which is not part of the general railroad system of transportation; or

(2) Used exclusively for rapid transit, commuter, or other short-haul passenger service in a metropolitan or suburban area.

(c) Until October 16, 1972, Subparts A, B, D (except § 213.109), E, and F of this part do not apply to track constructed or under construction before October 15, 1971. Until October 16, 1973, Subpart C and § 213.109 of Subpart D do not apply to track constructed or under construction before October 15, 1971.

§ 213.5 **Responsibility of track owners.**

(a) Any owner of track to which this part applies who knows or has notice that the track does not comply with the requirements of this part, shall—

(1) Bring the track into compliance; or

(2) Halt operations over that track.

(b) If an owner of track to which this part applies assigns responsibility for the track to another person (by lease or otherwise), any party to that assignment may petition the Federal Railroad Administrator to recognize the person to whom that responsibility is assigned for purposes of compliance with this part. Each petition must be in writing and include the following—

(1) The name and address of the track owner;

(2) The name and address of the person to whom responsibility is assigned (assignee);

(3) A statement of the exact relationship between the track owner and the assignee;

(4) A precise identification of the track;

(5) A statement as to the competence and ability of the assignee to carry out the duties of the track owner under this part; and

(6) A statement signed by the assignee acknowledging the assignment to him of responsibility for purposes of compliance with this part.

(c) If the Administrator is satisfied that the assignee is competent and able to carry out the duties and responsibilities of the track owner under this part, he may grant the petition subject to any conditions he deems necessary. If the Administrator grants a petition under this section, he shall so notify the owner and the assignee. After the Administrator grants a petition, he may hold the track owner or the assignee or both responsible for compliance with this part and subject to penalties under § 213.15.

§ 213.7 **Designation of qualified persons to supervise certain renewals and inspect track.**

(a) Each track owner to which this part applies shall designate qualified persons to supervise restorations and renewals of track under traffic conditions. Each person designated must have—

(1) At least—

(i) One year of supervisory experience in railroad track maintenance; or

(ii) A combination of supervisory experience in track maintenance and training from a course in track maintenance or from a college level educational program related to track maintenance;

(2) Demonstrated to the owner that he—

(i) Knows and understands the requirements of this part;

(ii) Can detect deviations from those requirements; and

(iii) Can prescribe appropriate remedial action to correct or safely compensate for those deviations; and

(3) Written authorization from the track owner to prescribe remedial actions to correct or safely compensate for deviations from the requirements in this part.

(b) Each track owner to which this part applies shall designate qualified persons to inspect track for defects. Each person designated must have—

(1) At least—

(i) One year of experience in railroad track inspection; or

(ii) A combination of experience in track inspection and training from a course in track inspection or from a college level educational program related to track inspection;

(2) Demonstrated to the owner that he—

(i) Knows and understands the requirements of this part;

(ii) Can detect deviations from those requirements; and

(iii) Can prescribe appropriate remedial action to correct or safely compensate for those deviations; and

(3) Written authorization from the track owner to prescribe remedial actions to correct or safely compensate for deviations from the requirements of this part, pending review by a qualified person designated under paragraph (a) of this section.

(c) With respect to designations under paragraphs (a) and (b) of this section, each track owner must maintain written records of—

(1) Each designation in effect;

(2) The basis for each designation, and

(3) Track inspections made by each designated qualified person as required by § 213.241.

These records must be kept available for inspection or copying by the Federal Railroad Administrator during regular business hours.

[36 FR 20336, Oct. 20, 1971, as amended at 38 FR 875, Jan. 5, 1973]

§ 213.9 Classes of track: operating speed limits.

(a) Except as provided in paragraphs (b) and (c) of this section and §§ 213.57 (b), 213.59(a), 213.105, 213.113 (a) and (b), and 213.137 (b) and (c), the following maximum allowable operating speeds apply:

[In miles per hour]

Over track that meets all of the requirements prescribed in this part for—	The maximum allowable operating speed for freight trains is—	The maximum allowable operating speed for passenger trains is—
Class 1 track	10	15
Class 2 track	25	30
Class 3 track	40	60
Class 4 track	60	80
Class 5 track	80	90
Class 6 track	110	110

(b) If a segment of track does not meet all of the requirements for its intended class, it is reclassified to the next lowest class of track for which it does meet all of the requirements of this part. However, if it does not at least meet the requirements for class 1 track, no operations may be conducted over that segment except as provided in § 213.11.

(c) Maximum operating speed may not exceed 110 m.p.h. without prior approval of the Federal Railroad Administrator. Petitions for approval must be filed in the manner and contain the information required by § 211.11 of this chapter. Each petition must provide sufficient information concerning the performance characteristics of the track, signaling, grade crossing protection, trespasser control where appropriate, and equipment involved and also concerning maintenance and inspection practices and procedures to be followed, to establish that the proposed speed can be sustained in safety.

[36 FR 20336, Oct. 20, 1971, as amended at 38 FR 875, Jan. 5, 1973; 38 FR 23405, Aug. 30, 1973]

§ 213.11 Restoration or renewal of track under traffic conditions.

If, during a period of restoration or renewal, track is under traffic conditions and does not meet all of the requirements prescribed in this part, the work and operations on the track must be under the continuous supervision of a person designated under § 213.7(a).

§ 213.13 Measuring track not under load.

When unloaded track is measured to determine compliance with requirements of this part, the amount of rail movement, if any, that occurs while the track is loaded must be added to the measurement of the unloaded track.

[38 FR 875, Jan. 5, 1973]

§ 213.15 Civil penalty.

(a) Any owner of track to which this part applies, or any person held by the Federal Railroad Administrator to be responsible under § 213.5(c), who violates any requirement prescribed in this part is subject to a civil penalty of at least $250 but not more than $2,500.

(b) For the purpose of this section, each day a violation persists shall be treated as a separate offense.

Exemptions.

(a) Any owner of track to which this part applies may petition the Federal Railroad Administrator for exemption from any or all requirements prescribed in this part.

(b) Each petition for exemption under this section must be filed in the manner and contain the information required by § 211.11 of this chapter.

(c) If the Administrator finds that an exemption is in the public interest and is consistent with railroad safety, he may grant the exemption subject to any conditions he deems necessary. Notice of each exemption granted is published in the FEDERAL REGISTER together with a statement of the reasons therefor.

Subpart B—Roadbed

§ 213.31 Scope.

This subpart prescribes minimum requirements for roadbed and areas immediately adjacent to roadbed.

§ 213.33 Drainage.

Each drainage or other water carrying facility under or immediately adjacent to the roadbed must be maintained and kept free of obstruction, to accommodate expected water flow for the area concerned.

§ 213.37 Vegetation.

Vegetation on railroad property which is on or immediately adjacent to roadbed must be controlled so that it does not—

(a) Become a fire hazard to track-carrying structures;

(b) Obstruct visibility of railroad signs and signals;

(c) Interfere with railroad employees performing normal trackside duties;

(d) Prevent proper functioning of signal and communication lines; or

(e) Prevent railroad employees from visually inspecting moving equipment from their normal duty stations.

Subpart C—Track Geometry

§ 213.51 Scope.

This subpart prescribes requirements for the gage, alinement, and surface of track, and the elevation of outer rails and speed limitations for curved track.

§ 213.53 Gage.

(a) Gage is measured between the heads of the rails at right angles to the rails in a plane five-eighths of an inch below the top of the rail head.

(b) Gage must be within the limits prescribed in the following table:

Class of track	The gage of tangent track must be—		The gage of curved track must be—	
	At least—	But not more than—	At least—	But not more than—
1	4′ 8″	4′ 9¾″	4′ 8″	4′ 9¾″
2 and 3	4′ 8″	4′ 9½″	4′ 8″	4′ 9¾″
4	4′ 8″	4′ 9¼″	4′ 8″	4′ 9½″
5	4′ 8″	4′ 9″	4′ 8″	4′ 9½″
6	4′ 8″	4′ 8¾″	4′ 8″	4′ 9″

§ 213.55 Alinement.

Alinement may not deviate from uniformity more than the amount prescribed in the following table:

Class of track	Tangent track	Curved track
	The deviation of the mid-offset from 62-foot line [1] may not be more than—	The deviation of the mid-ordinate from 62-foot chord [2] may not be more than—
1	5″	5″
2	3″	3″
3	1¾″	1¾″
4	1½″	1½″
5	¾″	⅝″
6	½″	⅜″

[1] The ends of the line must be at points on the gage side of the line rail, five-eighths of an inch below the top of the railhead. Either rail may be used as the line rail, however, the same rail must be used for the full length of that tangential segment of track.

[2] The ends of the chord must be at points on the gage side of the outer rail, five-eighths of an inch below the top of the railhead.

§ 213.57 Curves; elevation and speed limitations.

(a) Except as provided in § 213.63, the outside rail of a curve may not be lower than the inside rail or have more than 6 inches of elevation.

(b) The maximum allowable operating speed for each curve is determined by the following formula:

$$V_{max} = \sqrt{\frac{E_a + 3}{0.0007d}}$$

where

V_{max} = Maximum allowable operating speed (miles per hour).

E_a = Actual elevation of the outside rail (inches).

d = Degree of curvature (degrees).

Appendix A is a table of maximum allowable operating speed computed in accordance with this formula for various elevations and degrees of curvature.

§ 213.59 Elevation of curved track; runoff.

(a) If a curve is elevated, the full elevation must be provided throughout the curve, unless physical conditions do not permit. If elevation runoff occurs in a curve, the actual minimum elevation must be used in computing the maximum allowable operating speed for that curve under § 213.57(b).

(b) Elevation runoff must be at a uniform rate, within the limits of track surface deviation prescribed in § 213.63, and it must extend at least the full length of the spirals. If physical conditions do not permit a spiral long enough to accommodate the minimum length of runoff, part of the runoff may be on tangent track.

§ 213.61 Curve data for Classes 4 through 6 track.

(a) Each owner of track to which this part applies shall maintain a record of each curve in its Classes 4 through 6 track. The record must contain the following information:

(1) Location;

(2) Degree of curvature;

(3) Designated elevation;

(4) Designated length of elevation runoff; and

(5) Maximum allowable operating speed.

[38 FR 875, Jan. 5, 1973]

§ 213.63 Track surface.

Each owner of the track to which this part applies shall maintain the surface of its track within the limits prescribed in the following table:

Track surface	Class of track					
	1	2	3	4	5	6
The runoff in any 31 feet of rail at the end of a raise may not be more than	3½"	3"	2"	1½"	1"	½"
The deviation from uniform profile on either rail at the midordinate of a 62-foot chord may not be more than	3"	2¾"	2¼"	2"	1¼"	½"
Deviation from designated elevation on spirals may not be more than	1¾"	1½"	1¼"	1"	¾"	½"
ariation in cross level on spirals in any 31 feet may not be more than	2"	1¾"	1¼"	1"	¾"	½"
Deviation from zero cross level at any point on tangent or from designated elevation on curves between spirals may not be more than	3"	2"	1¾"	1¼"	1"	½"
The difference in cross level between any two points less than 62 feet apart on tangents and curves between spirals may not be more than	3"	2"	1¾"	1¼"	1"	½"

Subpart D—Track Structure

§ 213.101 Scope.

This subpart prescribes minimum requirements for ballast, crossties, track assembly fittings, and the physical condition of rails.

§ 213.103 Ballast; general.

Unless it is otherwise structurally supported, all track must be supported by material which will—

(a) Transmit and distribute the load of the track and railroad rolling equipment to the subgrade;

(b) Restrain the track laterally, longitudinally, and vertically under dynamic loads imposed by railroad rolling equipment and thermal stress exerted by the rails;

(c) Provide adequate drainage for the track; and

(d) Maintain proper track cross-level, surface, and alinement.

§ 213.105 Ballast; disturbed track.

If track is disturbed, a person designated under § 213.7 shall examine the track to determine whether or not the ballast is sufficiently compacted to perform the functions described in § 213.103. If the person making the examination considers it to be necessary in the interest of safety, operating speed over the disturbed segment of track must be reduced to a speed that he considers safe.

§ 213.109 Crossties.

(a) Crossties may be made of any material to which rails can be securely fastened. The material must be capable of holding the rails to gage within the limits prescribed in § 213.53(b) and distributing the load from the rails to the ballast section.

(b) A timber crosstie is considered to be defective when it is—

(1) Broken through;

(2) Split or otherwise impaired to the extent it will not hold spikes or will allow the ballast to work through;

(3) So deteriorated that the tie plate or base of rail can move laterally more than one-half inch relative to the crosstie;

(4) Cut by the tie plate through more than 40 percent of its thickness; or

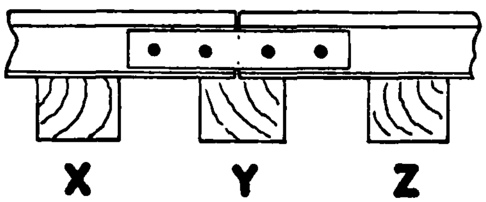
(5) Not spiked as required by § 213.127.

(c) If timber crossties are used, each 39 feet of track must be supported by nondefective ties as set forth in the following table:

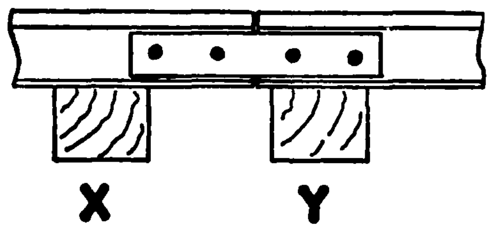
Class of track	Minimum number of nondefective ties per 39 feet of track	Maximum distance between nondefective ties (center to center) (inches)
1	5	100
2, 3	8	70
4, 5	12	48
6	14	48

(d) If timber ties are used, the minimum number of nondefective ties under a rail joint and their relative positions under the joint are described in the following chart. The letters in the chart correspond to letters underneath the ties for each type of joint depicted.

SUPPORTED JOINT



SUSPENDED JOINT



Class of track	Minimum number of nondefective ties under a joint	Required position of nondefective ties: Supported joint	Required position of nondefective ties: Suspended joint
1	1	X, Y, or Z	X or Y.
2, 3	1	Y	X or Y.
4, 5, 6	2	X and Y, or Y and Z.	X and Y.

(e) Except in an emergency or for a temporary installation of not more than 6-months duration, crossties may not be interlaced to take the place of switch ties.

[36 FR 20336, Oct. 20, 1971, as amended at 38 FR 875, Jan. 5, 1973]

§ 213.113 Defective rails.

(a) When an owner of track to which this part applies learns, through inspection or otherwise, that a rail in that track contains any of the defects listed in the following table, a person designated under § 213.7 shall determine whether or not the track may continue in use. If he determines that the track may continue in use, operation over the defective rail is not permitted until—

(1) The rail is replaced; or

(2) The remedial action prescribed in the table is initiated:

Remedial Action

Defect	Length of defect (inch): More than	Length of defect (inch): But not more than	Percent of railhead cross-sectional area weakened by defect: Less than	Percent of railhead cross-sectional area weakened by defect: But not less than	If defective rail is not replaced, take the remedial action prescribed in note—
Transverse fissure			20		B.
			100	20	B.
				100	A.
Compound fissure			20		B.
			100	20	B.
				100	A.
Detail fracture			20		C.
Engine burn fracture			100	20	D.
Defective weld				100	A, or E and H.
Horizontal split head	0	2			H and F.
	2	4			I and G.
Vertical split head	4				B.
	(Break out in railhead)				A.
Split web	0	½			H and F.
Piped rail	½	3			I and G.
Head web separation	3				B.
	(Break out in railhead)				A.
Bolt hole crack	0	½			H and F.
	½	1½			I and G.
	1½				B.
	(Break out in railhead)				A.
Broken base	0	6			E and I.
	6				(Replace rail).
Ordinary break					A or E.
Damaged rail					C.

NOTE:
A—*Assign person designated under § 213.7 to visually supervise each operation over defective rail.*
B—Limit operating speed to 10 m.p.h. over defective rail.
C—Apply joint bars bolted only through the outermost holes to defect within 20 days after it is determined to continue the track in use. In the case of classes 3 through 6 track, limit operating speed over defective rail to 30 m.p.h. until angle bars are applied; thereafter, limit speed to 50 m.p.h. or the maximum allowable speed under § 213.9 for the class of track concerned, whichever is lower.
D—Apply joint bars bolted only through the outermost holes to defect within 10 days after it is determined to continue the track in use. Limit operating speed over defective rail to 10 m.p.h. until angle bars are applied; thereafter, limit speed to 50 m.p.h. or the maximum allowable speed under § 213.9 for the class of track concerned, whichever is lower.
E—Apply joint bars to defect and bolt in accordance with § 213.121 (d) and (e).
F—Inspect rail 90 days after it is determined to continue the track in use.
G—Inspect rail 30 days after it is determined to continue the track in use.
H—Limit operating speed over defective rail to 50 m.p.h. or the maximum allowable speed under § 213.9 for the class of track concerned, whichever is lower.
I—Limit operating speed over defective rail to 30 m.p.h. or the maximum allowable speed under § 213.9 for the class of track concerned, whichever is lower.

(b) If a rail in classes 3 through 6 track or class 2 track on which passenger trains operate evidences any of the conditions listed in the following table, the remedial action prescribed in the table must be taken:

Condition	Remedial action: If a person designated under § 213.7 determines that condition requires rail to be replaced	Remedial action: If a person designated under § 213.7 determines that condition does not require rail to be replaced
Shelly spots Head checks Engine burn (but not fracture). Mill defect	Limit speed to 20 m.p.h. and schedule the rail for replacement.	Inspect the rail for internal defects at intervals of not more than every 12 months.
Flaking Slivered Corrugated Corroded	....do	Inspect the rail at intervals of not more than every 6 months.

(c) As used in this section—

(1) "Transverse Fissure" means a progressive crosswise fracture starting from a crystalline center or nucleus inside the head from which it spreads outward as a smooth, bright, or dark, round or oval surface substantially at a right angle to the length of the rail. The distinguishing features of a transverse fissure from other types of fractures or defects are the crystalline center or nucleus and the nearly smooth surface of the development which surrounds it.

(2) "Compound Fissure" means a progressive fracture originating in a horizontal split head which turns up or down in the head of the rail as a smooth, bright, or dark surface progressing until substantially at a right angle to the length of the rail. Compound fissures require examination of both faces of the fracture to locate the horizontal split head from which they originate.

(3) "Horizontal Split Head" means a horizontal progressive defect originating inside of the rail head, usually one-quarter inch or more below the running surface and progressing horizontally in all directions, and generally accompanied by a flat spot on the running surface. The defect appears as a crack lengthwise of the rail when it reaches the side of the rail head.

(4) "Vertical Split Head" means a vertical split through or near the middle of the head, and extending into or through it. A crack or rust streak may show under the head close to the web or pieces may be split off the side of the head.

(5) "Split Web" means a lengthwise crack along the side of the web and extending into or through it.

(6) "Piped Rail" means a vertical split in a rail, usually in the web, due to failure of the sides of the shrinkage cavity in the ingot to unite in rolling.

(7) "Broken Base" means any break in the base of a rail.

(8) "Detail Fracture" means a progressive fracture originating at or near the surface of the rail head. These fractures should not be confused with transverse fissures, compound fissures, or other defects which have internal origins. Detail fractures may arise from shelly spots, head checks, or flaking.

(9) "Engine Burn Fracture" means a progressive fracture originating in spots where driving wheels have slipped on top of the rail head. In developing downward they frequently resemble the compound or even transverse fissure with which they should not be confused or classified.

(10) "Ordinary Break" means a partial or complete break in which there is no sign of a fissure, and in which none of the other defects described in this paragraph are found.

(11) "Damaged rail" means any rail broken or injured by wrecks, broken, flat, or unbalanced wheels, slipping, or similar causes.

(12) "Shelly spots" means a condition where a thin (usually three-eighths inch in depth or less) shell-like piece of surface metal becomes separated from the parent metal in the railhead, generally at the gage corner. It may be evidenced by a black spot appearing on the railhead over the zone of separation or a piece of metal breaking out completely, leaving a shallow cavity in the railhead. In the case of a small shell there may be no surface evidence, the existence of the shell being apparent only after the rail is broken or sectioned.

(13) "Head checks" mean hair fine cracks which appear in the gage corner of the rail head, at any angle with the length of the rail. When not readily visible the presence of the checks may often be detected by the raspy feeling of their sharp edges.

(14) "Flaking" means small shallow flakes of surface metal generally not more than one-quarter inch in length or width break out of the gage corner of the railhead.

[36 FR 20336, Oct. 20, 1971, as amended at 38 FR 875, Jan. 5, 1973; 38 FR 1508, Jan. 15, 1973]

§ 213.115 Rail end mismatch.

Any mismatch of rails at joints may not be more than that prescribed by the following table:

Class of track	Any mismatch of rails at joints may not be more than the following—	
	On the trend of the rail ends (inch)	On the gage side of the rail ends (inch)
1	1/4	1/4
2	1/4	3/16
3	3/16	3/16
4, 5	1/8	1/8
6	1/8	1/8

§ 213.117 Rail end batter.

(a) Rail end batter is the depth of depression at one-half inch from the rail end. It is measured by placing an 18-inch straightedge on the tread on the rail end, without bridging the joint, and measuring the distance between the bottom of the straightedge and the top of the rail at one-half inch from the rail end.

(b) Rail end batter may not be more than that prescribed by the following table:

Class of track	*Rail end batter may not be more than—(inch)*
1	1/2
2	3/8
3	3/8
4	1/4
5	1/8
6	1/8

§ 213.119 Continuous welded rail.

(a) When continuous welded rail is being installed, it must be installed at, or adjusted for, a rail temperature range that should not result in compressive or tensile forces that will produce lateral displacement of the track or pulling apart of rail ends or welds.

(b) After continuous welded rail has been installed it should not be disturbed at rail temperatures higher than its installation or adjusted installation temperature.

§ 213.121 Rail joints.

(a) Each rail joint, insulated joint, and compromise joint must be of the proper design and dimensions for the rail on which it is applied.

(b) If a joint bar on classes 3 through 6 track is cracked, broken, or because of wear allows vertical movement of either rail when all bolts are tight, it must be replaced.

(c) If a joint bar is cracked or broken between the middle two bolt holes it must be replaced.

(d) In the case of conventional jointed track, each rail must be bolted with at least two bolts at each joint in classes 2 through 6 track, and with at least one bolt in class 1 track.

(e) In the case of continuous welded rail track, each rail must be bolted with at least two bolts at each joint.

(f) Each joint bar must be held in position by track bolts tightened to allow the joint bar to firmly support the abutting rail ends and to allow longitudinal movement of the rail in the joint to accommodate expansion and contraction due to temperature variations. When out-of-face, no-slip, joint-to-rail contact exists by design, the requirements of this paragraph do not apply. Those locations are considered to be continuous welded rail track and must meet all the requirements for continuous welded rail track prescribed in this part.

(g) No rail or angle bar having a torch cut or burned bolt hole may be used in classes 3 through 6 track.

§ 213.123 Tie plates.

(a) In classes 3 through 6 track where timber crossties are in use there must be tie plates under the running rails on at least eight of any 10 consecutive ties.

(b) Tie plates having shoulders must be placed so that no part of the shoulder is under the base of the rail.

§ 213.125 Rail anchoring.

Longitudinal rail movement must be effectively controlled. If rail anchors which bear on the sides of ties are used for this purpose, they must be on the same side of the tie on both rails.

§ 213.127 Track spikes.

(a) When conventional track is used with timber ties and cut track spikes, the rails must be spiked to the ties with at least one line-holding spike on the gage side and one line-holding spike on the field side. The total number of track spikes per rail per tie, including plate-holding spikes, must be at least the number prescribed in the following table:

MINIMUM NUMBER OF TRACK SPIKES PER RAIL PER TIE, INCLUDING PLATE-HOLDING SPIKES

Class of track	Tangent track and curved track with not more than 2° of curvature	Curved track with more than 2° but not more than 4° of curvature	Curved track with more than 4° but not more than 6° of curvature	Curved track with more than 6° of curvature
1	2	2	2	2
2	2	2	2	3
3	2	2	2	3
4	2	2	3	----------
5	2	3	----------	----------
6	2	----------	----------	----------

(b) A tie that does not meet the requirements of paragraph (a) of this section is considered to be defective for the purposes of § 213.109(b).

[36 FR 20336, Oct. 20, 1971, as amended at 38 FR 876, Jan. 5, 1973]

§ 213.129 Track shims.

(a) If track does not meet the geometric standards in Subpart C of this part and working of ballast is not possible due to weather or other natural conditions, track shims may be installed to correct the deficiencies. If shims are used, they must be removed and the track resurfaced as soon as weather and other natural conditions permit.

(b) When shims are used they must be—

(1) At least the size of the tie plate;

(2) Inserted directly on top of the tie, beneath the rail and tie plate;

(3) Spiked directly to the tie with spikes which penetrate the tie at least 4 inches.

(c) When a rail is shimmed more than 1½ inches, it must be securely braced on at least every third tie for the full length of the shimming.

(d) When a rail is shimmed more than 2 inches a combination of shims and 2-

inch or 4-inch planks, as the case may be, must be used with the shims on top of the planks.

§ 213.131 Planks used in shimming.

(a) Planks used in shimming must be at least as wide as the tie plates, but in no case less than 5½ inches wide. Whenever possible they must extend the full length of the tie. If a plank is shorter than the tie, it must be at least 3 feet long and its outer end must be flush with the end of the tie.

(b) When planks are used in shimming on uneven ties, or if the two rails being shimmed heave unevenly, additional shims may be placed between the ties and planks under the rails to compensate for the unevenness.

(c) Planks must be nailed to the ties with at least four 8-inch wire spikes. Before spiking the rails or shim braces, planks must be bored with ⅝-inch holes.

§ 213.133 Turnouts and track crossings generally.

(a) In turnouts and track crossings, the fastenings must be intact and maintained so as to keep the components securely in place. Also, each switch, frog, and guard rail must be kept free of obstructions that may interfere with the passage of wheels.

(b) Classes 4 through 6 track must be equipped with rail anchors through and on each side of track crossings and turnouts, to restrain rail movement affecting the position of switch points and frogs.

(c) Each flangeway at turnouts and track crossings must be at least 1½ inches wide.

[36 FR 20336, Oct. 20, 1971, as amended at 38 FR 876, Jan. 5, 1973]

§ 213.135 Switches.

(a) Each stock rail must be securely seated in switch plates, but care must be used to avoid canting the rail by overtightening the rail braces.

(b) Each switch point must fit its stock rail properly, with the switch stand in either of its closed positions to allow wheels to pass the switch point. Lateral and vertical movement of a stock rail in the switch plates or of a switch plate on a tie must not adversely affect the fit of the switch point to the stock rail.

(c) Each switch must be maintained so that the outer edge of the wheel tread cannot contact the gage side of the stock rail.

(d) The heel of each switch rail must be secure and the bolts in each heel must be kept tight.

(e) Each switch stand and connecting rod must be securely fastened and operable without excessive lost motion.

(f) Each throw lever must be maintained so that it cannot be operated with the lock or keeper in place.

(g) Each switch position indicator must be clearly visible at all times.

(h) Unusually chipped or worn switch points must be repaired or replaced. Metal flow must be removed to insure proper closure.

§ 213.137 Frogs.

(a) The flangeway depth measured from a plane across the wheel-bearing area of a frog on class 1 track may not be less than 1⅜ inches, or less than 1½ inches on classes 2 through 6 track.

(b) If a frog point is chipped, broken, or worn more than five-eighths inch down and 6 inches back, operating speed over that frog may not be more than 10 miles per hour.

(c) If the tread portion of a frog casting is worn down more than three-eighths inch below the original contour, operating speed over that frog may not be more than 10 miles per hour.

§ 213.139 Spring rail frogs.

(a) The outer edge of a wheel tread may not contact the gage side of a spring wing rail.

(b) The toe of each wing rail must be solidly tamped and fully and tightly bolted.

(c) Each frog with a bolt hole defect or head-web separation must be replaced.

(d) Each spring must have a tension sufficient to hold the wing rail against the point rail.

(e) The clearance between the hold-down housing and the horn may not be more than one-fourth of an inch.

§ 213.141 Self-guarded frogs.

(a) The raised guard on a self-guarded frog may not be worn more than three-eighths of an inch.

(b) If repairs are made to a self-guarded frog without removing it from service, the guarding face must be restored before rebuilding the point.

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§ 213.143 **Frog guard rails and guard faces; gage.**

The guard check and guard face gages in frogs must be within the limits prescribed in the following table:

Class of track	Guard check gage — The distance between the gage line of a frog to the guard line [1] of its guard rail or guarding face, measured across the track at right angles to the gage line, [2] may not be less than—	Guard face gage — The distance between guard lines, [1] measured across the track at right angles to the gage line, [2] may not be more than—
1	4′ 6⅛″	4′ 5¼″
2	4′ 6¼″	4′ 5⅛″
3, 4	4′ 6⅜″	4′ 5⅛″
5, 6	4′ 6½″	4′ 5″

[1] A line along that side of the flangeway which is nearer to the center of the track and at the same elevation as the gage line.

[2] A line ⅝ inch below the top of the center line of the head of the running rail, or corresponding location of the tread portion of the track structure.

Subpart E—Track Appliances and Track-Related Devices

§ 213.201 **Scope.**

This subpart prescribes minimum requirements for certain track appliances and track-related devices.

§ 213.205 **Derails.**

(a) Each derail must be clearly visible. When in a locked position a derail must be free of any lost motion which would allow it to be operated without removing the lock.

(b) When the lever of a remotely controlled derail is operated and latched it must actuate the derail.

§ 213.207 **Switch heaters.**

The operation of a switch heater must not interfere with the proper operation of the switch or otherwise jeopardize the safety of railroad equipment.

Subpart F—Inspection

§ 213.231 **Scope.**

This subpart prescribes requirements for the frequency and manner of inspecting track to detect deviations from the standards prescribed in this part.

§ 213.233 **Track inspections.**

(a) All track must be inspected in accordance with the schedule prescribed in paragraph (c) of this section by a person designated under § 213.7.

(b) Each inspection must be made on foot or by riding over the track in a vehicle at a speed that allows the person making the inspection to visually inspect the track structure for compliance with this part. However, mechanical or electrical inspection devices approved by the Federal Railroad Administrator may be used to supplement visual inspection. If a vehicle is used for visual inspection, the speed of the vehicle may not be more than 5 miles per hour when passing over track crossings, highway crossings, or switches.

(c) Each track inspection must be made in accordance with the following schedule:

Class of track	Type of track	Required frequency
1, 2, 3	Main track and sidings.	*Weekly* with at least 3 calendar days interval between inspections, or *before use*, if the track is used less than once a week, or *twice weekly* with at least 1 calendar day interval between inspections, if the track carries passenger trains or more than 10 million gross tons of traffic during the preceding calendar year.
1, 2, 3	Other than main track and sidings.	*Monthly* with at least 20 calendar days interval between inspections.
4, 5, 6		*Twice weekly* with at least 1 calendar day interval between inspections.

(d) If the person making the inspection finds a deviation from the requirements of this part, he shall immediately initiate remedial action.

[36 FR 20336, Oct. 20, 1971, as amended at 38 FR 876, Jan. 5, 1973]

§ 213.235 **Switch and track crossing inspections.**

(a) Except as provided in paragraph (b) of this section, each switch and track crossing must be inspected on foot at least monthly.

(b) In the case of track that is used less than once a month, each switch and track crossing must be inspected on foot before it is used.

§ 213.237 ***Inspection of rail.***

(a) In addition to the track inspections required by § 213.233, at least once a year a continuous search for internal defects must be made of all jointed and welded rails in Classes 4 through 6 track, and Class 3 track over which passenger trains operate. However, in the case of a new rail, if before installation or within 6 months thereafter it is inductively or ultrasonically inspected over its entire length and all defects are removed, the next continuous search for internal defects need not be made until 3 years after that inspection.

(b) Inspection equipment must be capable of detecting defects between joint bars, in the area enclosed by joint bars.

(c) Each defective rail must be marked with a highly visible marking on both sides of the web and base.

[36 FR 20336, Oct. 20, 1971, as amended at 38 FR 876, Jan. 5, 1973]

§ 213.239 Special inspections.

In the event of fire, flood, severe storm, or other occurrence which might have damaged track structure, a special inspection must be made of the track involved as soon as possible after the occurrence.

§ 213.241 Inspection records.

(a) Each owner of track to which this part applies shall keep a record of each inspection required to be performed on that track under this subpart.

(b) Each record of an inspection under §§ 213.233 and 213.235 shall be prepared on the day the inspection is made and signed by the person making the inspection. Records must specify the track inspected, date of inspection, location and nature of any deviation from the requirements of this part, and the remedial action taken by the person making the inspection. The owner shall retain each record at its division headquarters for at least 1 year after the inspection covered by the record.

(c) Rail inspection records must specify the date of inspection, the location, and nature of any internal rail defects found, and the remedial action taken and the date thereof. The owner shall retain a rail inspection record for at least 2 years after the inspection and for 1 year after remedial action is taken.

(d) Each owner required to keep inspection records under this section shall make those records available for inspection and copying by the Federal Railroad Administrator.

APPENDIX A—MAXIMUM ALLOWABLE OPERATING SPEEDS FOR CURVED TRACK

Elevation of outer rail (inches)

Degree of Curvature	0	½	1	1½	2	2½	3	3½	4	4½	5	5½	6
	Maximum allowable operating speed (mph)												
0°30′	93	100	107										
0°40′	80	87	93	98	103	109							
0°50′	72	78	83	88	93	97	101	106	110				
1°00′	66	71	76	80	85	89	93	96	100	104	107	110	
1°15′	59	63	68	72	76	79	83	86	89	93	96	99	1 01
1°30′	54	58	62	66	69	72	76	79	82	85	87	90	93
1°45′	50	54	57	61	64	67	70	73	76	78	81	83	86
2°00′	46	50	54	57	60	63	66	68	71	73	76	78	80
2°15′	44	47	50	54	56	59	62	64	67	69	71	74	76
2°30′	41	45	48	51	54	56	59	61	63	66	68	70	72
2°45′	40	43	46	48	51	54	56	58	60	62	65	66	68
3°00′	38	41	44	46	49	51	54	56	58	60	62	64	66
3°15′	36	39	42	45	47	49	51	54	56	57	59	61	63
3°30′	35	38	40	43	45	47	50	52	54	55	57	59	61
3°45′	34	37	39	41	44	46	48	50	52	54	55	57	59
4°00′	33	35	38	40	42	44	46	48	50	52	54	55	57
4°30′	31	33	36	38	40	42	44	45	47	49	50	52	54
5°00′	29	32	34	36	38	40	41	43	45	46	48	49	51
5°30′	28	30	32	34	36	38	40	41	43	44	46	47	48
6°00′	27	29	31	33	35	36	38	39	41	42	44	45	46
6°30′	26	28	30	31	33	35	36	38	39	41	42	43	45
7°00′	25	27	29	30	32	34	35	36	38	39	40	42	43
8°00′	23	25	27	28	30	31	33	34	35	37	38	39	40
9°00′	22	24	25	27	28	30	31	32	33	35	36	37	38
10°00′	21	22	24	25	27	28	29	31	32	33	34	35	36
11°00′	20	21	23	24	26	27	28	29	30	31	32	33	34
12°00′	19	20	22	23	24	26	27	28	29	30	31	32	3

[36 FR 20336, Oct. 20, 1971, as amended at 38 FR 876, Jan. 5, 1973]

APPENDIX B

PROPOSED RAIL OUTLOADING PROCEDURE FOR A MOBILIZATION MOVE AT FORT IRWIN

Maximum rail outloading operations use a cyclic schedule to minimize conflicts and improve control. The recommended outloading plan, Plan 4, is shown in figures 64 through 70. All plans follow the same basic idea as the following simulation for Plan 4. The simulation begins with the assumption that it takes several days to accumulate the necessary number of railcars to start full-scale outloading operations. The switching locomotive positions the arriving railcars at the designated loading sites according to a preconceived plan, while at the same time, the equipment to be loaded aboard the cars is being prepared and staged. Some personnel should be used to act as road guards at all crossings to reduce delays and insure a safer operation.

The simulation of Plan 4 proceeds as follows: Before dawn, the empty railcars are in place at the loading sites and the equipment to be loaded is staged; at dawn, which is defined as zero hour in the cycle, loading begins and the equipment is tied down or blocked and braced, whichever is appropriate. At this point, the loaded railcars are ready to be moved from the loading site; 7 hours have elapsed. Now, as shown in figure 64 at the Manix site, the main line locomotive number 1 couples with the 29 loaded cars (C-29-L) on the Manix spur, with 30 minutes elapsing. At this time, a switching locomotive with 29 empty cars transits to the passing track and waits 10 minutes. Now, the main line locomotive transits (TR) to the main line with the 29 loaded cars. Next, the switching locomotive transits (TR) to the Manix spur with 29 empty cars. Now, the main line locomotive number 1 uncouples the 29 loaded cars (UC-29-L) and the main line locomotive number 2 couples with the 29 loaded cars and leaves the site for Barstow. Two main line locomotives are required because number 1 is on the wrong side of the string of cars to pull them back to Barstow. At the same time, the switching locomotive is uncoupling 29 empty cars (UC-29-E). The switching cycle is finished with an elapsed time of 1 hour and 15 minutes, which makes a total cycle time of 8 hours and 15 minutes. The string of empty cars is now ready to be loaded with equipment for the next cycle. The operating times used in the analysis are shown in table 17. All of the other loading sites, figures 65 through 70, operate similarly to the Manix site. The Daggett Airport site was not included in the analysis, but the simulation, figure 70, was included in case the property lease expires and the site becomes available for outloading.

LEGEND	
C	COUPLE
UC	UNCOUPLE
TR	TRANSIT
L	LOADED
E	EMPTY
30	NUMBER OF RAILCARS
(15)	TIME EXPENDED IN MINUTES
MN	MAIN LINE TRACK
MP	PASSING TRACK
MS	SPUR TRACK
SB	SET BRAKES
WT	WAIT

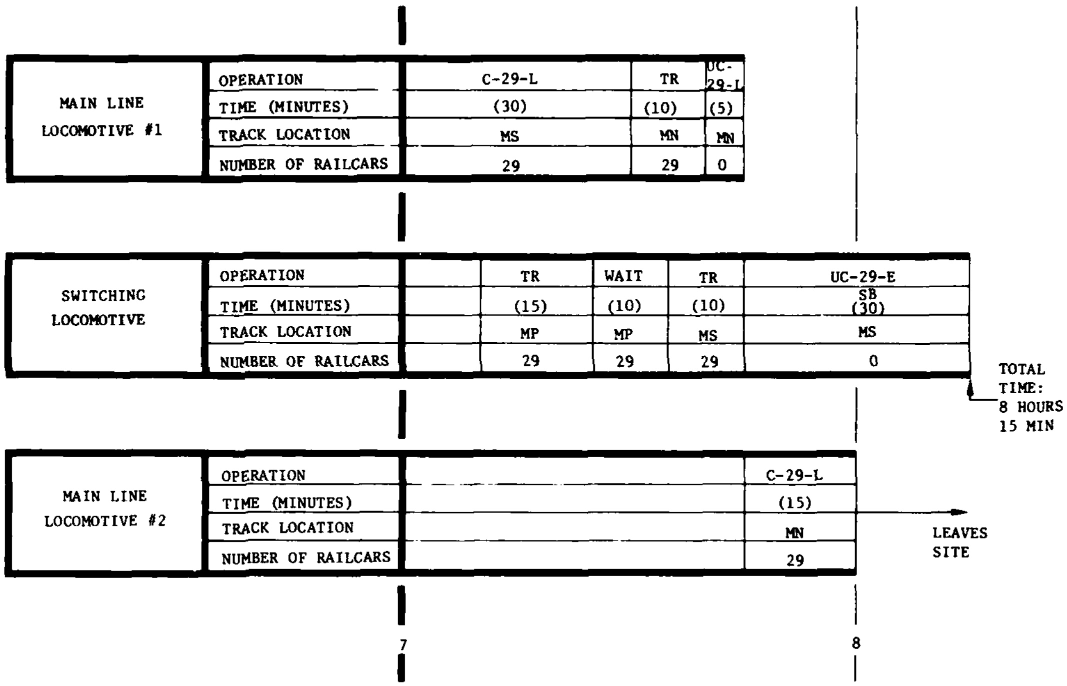

Figure 64. Rail outloading simulation plan - Manix.

LEGEND	
C	COUPLE
UC	UNCOUPLE
TR	TRANSIT
L	LOADED
E	EMPTY
30	NUMBER OF RAILCARS
(15)	TIME EXPENDED IN MINUTES
HE	HOUSE TRACK EAST
HW	HOUSE TRACK WEST
C	CLEANING TRACK
T	MARINE TAIL TRACK
S	WYE SPUR TRACK
ST2	STORAGE TRACK NO. 2
ST6	STORAGE TRACK NO. 6
ST7	STORAGE TRACK NO. 7
ST8	STORAGE TRACK NO. 2
ST10	STORAGE TRACK NO. 10
SB	SET BRAKES
WT	WAIT

MAIN LINE LOCOMOTIVE #2	OPERATION
	TIME (MINUT
	TRACK LOCAT
	NUMBER OF RA

SWITCHING LOCOMOTIVE "1	OPERATION
	TIME (MINUTE
	TRACK LOCATI
	NUMBER OF RA

MAIN LINE LOCOMOTIVE #2	OPERATION
	TIME (MINUTE
	TRACK LOCATI
	NUMBER OF RA

SWITCHING LOCOMOTIVE #2	OPERATION
	TIME (MINUTE
	TRACK LOCATI
	NUMBER OF RA

Figure 65. Rail outloading simulation plan - UP Yermo.

ATION		C-24-E	TR	UC-24-E	TR	C-26-E	TR	
(MINUTES)		(25)	(5)	SB (25)	(5)	(30)	(10)	
K LOCATION		ST8	C	C	ST7	ST7	T	
ER OF RAILCARS		24	24	0	0	26	26	

ATION	C-24-L	TR	UC-24-L	TR	C-24-L	C-19-L
(MINUTES)	(25)	(5)	(5)	SB (10)	(10)	(10)
K LOCATION	C	ST10	ST10	ST10	ST10	ST10
ER OF RAILCARS	24	24	0	0	24	43

→ LEAVES YARD

ATION	C-4-L	TR	C-15-L	TR	UC-19-L	TR	C-19-E	TR	UC-15-E	TR	UC-4-E	TR
(MINUTES)	(5)	(10)	(15)	(10)	(5)	(10)	(20)	(10)	SB (15)	(10)	SB (5)	(10)
CK LOCATION	S	HE	HE	ST10	ST10	ST2	ST2	HE	HE	S	S	ST6
ER OF RAILCARS	4	4	19	19	0	0	19	19	4	4	0	0

	UC-30-E
	SB (30)
	T
	0

TOTAL TIME:
9 HOURS-40 MIN

UC-A-E	TR	C-15-E	TR	UC-15-E
SB (5)	(10)	(15)	(5)	SB (15)
S	ST6	ST6	HW	HW
0	0	15	15	0

LEGEND	
C	COUPLE
UC	UNCOUPLE
TR	TRANSIT
L	LOADED
E	EMPTY
30	NUMBER OF RAILCARS
(15)	TIME EXPENDED IN MINUTES
SF-1	SPUR TRACK IN OLD YARD
SF-2	SPUR TRACK IN OLD YARD
SF-3	SPUR TRACK AT RADIO TOWER
T-1	STORAGE TRACK IN OLD YARD
T-2	STORAGE TRACK IN OLD YARD
T-3	STORAGE TRACK IN OLD YARD
SB	SET BRAKES
WT	WAIT

MAIN LINE LOCOMOTIVE	OPERATION
	TIME (MINUTES)
	TRACK LOCATION
	NUMBER OF RAILCARS

SWITCHING LOCOMOTIVE #1	OPERATION
	TIME (MINUTES)
	TRACK LOCATION
	NUMBER OF RAILCARS

SWITCHING LOCOMOTIVE #2	OPERATION
	TIME (MINUTES)
	TRACK LOCATION
	NUMBER OF RAILCARS

Figure 66. Rail outloading simulation plan - ATSF Barstow.

ATION	C-40-L	TR	WT	C-12-L
(MINUTES)	(40)	(20)	(5)	(5)
CK LOCATION	SF-3	T-1	T-1	T-1
ER OF RAILCARS	40	40	40	52

LEAVES YARD

ATION	C-5-L	TR	C-7-L	TR	UC-12-L	TR	C-12-E	TR	UC-7-E SB	
(MINUTES)	(5)	(40)	(10)	(5)	(5)	(5)	(15)	(5)	(10)	
CK LOCATION	SF-1	SF-2	SF-2	T-1	T-1	T-2	T-2	SF-2	SF-2	
ER OF RAILCARS	5	5	12	12	0	0	12	12	5	

ATION		C-40-E	TR	UC-40-E SB
E (MINUTES)		(40)	(20)	(40)
CK LOCATION		T-3	SF-3	SF-3
BER OF RAILCARS		40	40	0

TR	UC-5-E
(40)	SB (10)
SF-1	SF-1
7	0

TOTAL TIME:
9 HRS-30 MIN

0-E
B 0)
-3
0

9

LEGEND	
C	COUPLE
UC	UNCOUPLE
TR	TRANSIT
L	LOADED
E	EMPTY
30	NUMBER OF RAILCARS
(15)	TIME EXPENDED IN MINUTES
446	SPUR BY RAMP 446
447	SPUR BY RAMP 447
448	SPUR BY RAMP 448
N18	TRACK NORTH ON 18th ST
S18	TRACK SOUTH ON 18th ST
SB	SET BRAKES
WT	WAIT

MAIN LINE LOCOMOTIVE	OPERATION
	TIME (MINUTES)
	TRACK LOCATION
	NUMBER OF RAILCARS

SWITCHING LOCOMOTIVE	OPERATION
	TIME (MINUTES)
	TRACK LOCATION
	NUMBER OF RAILCARS

CYCLE

Figure 67. Rail outloading simulation plan - USMC Yermo.

TION	C-8-L	TR	UC-8-L	TR	C-8-L	C-15-L
(MINUTES)	(10)	(5)	(5)	(10)	(5)	(5)
LOCATION	447	N18	N18	N18	N18	N18
R OF RAILCARS	8	8	0	0	8	23

TION		C-8-L	TR	C-7-L	TR	UC-15-L	TR
(MINUTES)		(10)	(5)	(10)	(5)	(5)	(5)
LOCATION		448	446	446	N18	N18	S18
R OF RAILCARS		8	8	15	15	0	0

7

CYCLE TIME IN HOURS

LEGEND	
C	COUPLE
UC	UNCOUPLE
TR	TRANSIT
L	LOADED
E	EMPTY
30	NUMBER OF RAILCARS
(15)	TIME EXPENDED IN MINUTES
S-1	TRACK BY STRUCTURE 1
S-2	TRACK BY STRUCTURE 2
S-3	TRACK BY STRUCTURE 3
S-45	TRACK BY STRUCTURE 45
S-56	TRACK BY STRUCTURE 56
S-211	TRACK BY STRUCTURE 211
SB	SET BRAKES
WT	WAIT

MAIN LINE LOCOMOTIVE					
OPERATION	C-15-L	TR	TR	C-5-L	
TIME (MINUTES)	(15)	(5)	(10)	(5)	→ LEAVES POST
TRACK LOCATION	S-211	S-56	S-1	S-1	
NUMBER OF RAILCARS	15	15	15	20	

SWITCHING LOCOMOTIVE											
OPERATION	C-5-L	TR	UC-5-L	TR	C-5-E	TR	UC-5-E	TR	C-15-E	TR	UC-15-E
TIME (MINUTES)	(5)	(5)	(5)	(5)	(5)	(5)	SB (5)	(10)	(15)	(10)	SB (15)
TRACK LOCATION	S-45	S-1	S-1	S-2	S-2	S-45	S-45	S-3	S-3	S-211	S-211
NUMBER OF RAILCARS	5	5	0	0	5	5	0	0	15	15	0

TOTAL TIME: 8 HRS 25 MIN

7

8

CYCLE TIME IN HOURS

Figure 68. Rail outloading simulation plan - USMC Nebo.

LEGEND	
C	COUPLE
UC	UNCOUPLE
TR	TRANSIT
L	LOADED
E	EMPTY
30	NUMBER OF RAILCARS
(15)	TIME EXPENDED IN MINUTES
HP	PASSING TRACK
HS	SPUR TRACK
SB	SET BRAKES
WT	WAIT

MAIN LINE LOCOMOTIVE	OPERATION	C-16-L
	TIME (MINUTES)	(15)
	TRACK LOCATION	HS
	NUMBER OF RAILCARS	16

LEAVES SITE

SWITCHING LOCOMOTIVE	OPERATION	TR	TR	UC-16-E
	TIME (MINUTES)	(15)	(5)	SB (15)
	TRACK LOCATION	HP	HS	HS
	NUMBER OF RAILCARS	16	16	0

TOTAL TIME: 7 HRS-35 MIN

7

CYCLE TIME IN HOURS

Figure 69. Rail outloading simulation plan - ATSF Hinkley.

LEGEND	
C	COUPLE
UC	UNCOUPLE
TR	TRANSIT
L	LOADED
E	EMPTY
30	NUMBER OF RAILCARS
(15)	TIME EXPENDED BY MINUTES
M	MAIN LINE TRACK
DN	NORTH SPUR
DS	SOUTH SPUR
SB	SET BRAKES
WT	WAIT

MAIN LINE LOCOMOTIVE				
	OPERATION	C-15-L	TR	C-8-L
	TIME (MINUTES)	(15)	(5)	(10)
	TRACK LOCATION	DS	DN	DN
	NUMBER OF RAILCARS	15	15	23

SWITCHING LOCOMOTIVE								
	OPERATION		TR FROM CITY OF DAGGETT	W	TR	UC-8-E SB	TR	UC-15-E SB
	TIME (MINUTES)		(15)	(5)	(5)	(10)	(5)	(15)
	TRACK LOCATION		M	M	DN	DN	DS	DS
	NUMBER OF RAILCARS		23	23	23	15	15	0

7 8

CYCLE TIME IN HOURS

Figure 70. Rail outloading simulation plan - Daggett Airport.

TABLE 17
TIMES REQUIRED FOR VARIOUS RAILCAR SWITCHING OPERATIONS AND LOCOMOTIVE CAPABILITY

Empty

C-15-E (5 min)
C-30-E (10 min)
C-45-E (15 min)
UC-15-E (1-2 min)
UC-15-E (SB) (15 min)
UC-30-E (SB) (30 min)

SB = Set Brakes
Set brakes if cars are to be left overnight or loaded or on a steep grade.

Loaded

C-15-L (5 min)
C-30-L (10 min)
C-45-L (15 min)
But if cars have been sitting overnight brakes must be checked
C-15-L (15 min)
C-30-L (30 min) (or 15 min for 2 men)
C-45-L (45 min) (or 15 min for 3 men)
UC-15-L (1-2 min)
UC-15-L (SB) (15 min)
UC-30-L (SB) (30 min)

Note:
Above times are for daylight operations, add 5 minutes for night if brakes have to be set or checked.

TRANSIT SPEED

Average for all switching operations, 5 miles per hour. Engine with no railcars, 10 miles per hour for distances of one-half mile or more, except for nighttime, then add 5 minutes for each transit.

LOCOMOTIVE CAPABILITY

120-ton locomotive-- 1200 tons on 2.5% grade
Empties--34 cars
Loaded--24 cars
2 M-60 tanks on series 38 car, 9 cars per locomotive
16 cars per locomotive with 1 tank per 57-foot car
2 locomotives--2 times above capabilities

Speed vs Time

@5 miles per hour, time in minutes = .00227 min/ft (distance in feet)
@10 miles per hour, time in minutes = .00114 min/ft (distance in feet)
@26 miles per hour, time in minutes = .000438 min/ft (distance in feet)

APPENDIX C

SPECIAL-PURPOSE RAILCARS AND LOADING/UNLOADING PROCEDURES

Specially designed railcars, in particular those used for transporting vehicles, can greatly increase the speed and efficiency of a rail outloading operation. Bilevel, trilevel, and integral chain tiedown flatcars are the primary means of enhancing the loadout routine of most military vehicles. Bilevel and trilevel railcars are best suited for the smaller vehicles, including 2-1/2-ton trucks.

The integral tiedown flatcars will accommodate larger vehicles, including tanks. Loading and securing equipment on these railcars can be accelerated to 15 minutes per vehicle, for small vehicles, versus approximately 45 minutes for blocking and bracing procedures used on standard-type railcars. Also, the BTTX 89-foot flatcar has a capacity of six 2-1/2-ton trucks, doubling the single level capacity. Thus, in speed and capacity, special-purpose railcars are an advantage worth investigating.

There are essentially five methods of loading/unloading multilevel railcars, they are:

1. The "K" loader of 463L aircraft cargo-loading system.
2. The forklift and pallet used in conjunction with a crane and/or ramp.
3. The crane and ramp combination.
4. Adjustable ramps.
5. Adjustable built-in ramp on multilevel railcars.

The procedures used with each of the above are described in detail in TM 55-625[2/], as are tiedown procedures.

As of 1970, more than 70 percent of DOD installations had no organic capability to load/unload multilevel railcars. No outloading plans should include the use of these railcars until a thorough investigation verifies

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[2/] TM 55-625, Transportability Criteria and Guidanee, Loading and Unloading Multilevel Railcars at Military Installations in the United States.

their availability at the time required. The supply of special-purpose flatcars with integral tiedowns is also limited. As a result, even though these types of railcars are very valuable for volume rail outloading operations, their availability is seriously in question unless advance preparations are made.

The following trends in flatcar supply are now operative and have been since the development of modern piggyback service in the mid-1950's:

1. The size of the flatcar fleet has been growing, both in number of flatcars and in relation to the size of the car fleet as a whole. This gain has been confined to specialized cars; for example, trailer-on-flatcar, container-on-flatcar, bilevel, trilevel, and bulkhead flatcars.

2. The size of the general-purpose flatcar fleet has decreased, though average length and capacity have increased.

3. A majority of all flatcars are owned by car companies, not by the railroads. Therefore, more flexibility in assignment, with improved utilization, has resulted. Fewer idle cars available for short-notice use than would be if each railroad maintained an adequate supply for its own needs.

Considering these trends, the sizes of the various components of the specialized flatcar fleet, and the blocking and bracing requirements for the various types of equipment to be shipped by rail, it does not appear prudent to express an installation's needs and outloading plan using only general-purpose flats. The TOFC fleet, in particular, is now most likely large enough to fill military requirements (table 18). The COFC fleet also has expanded to the point that it could carry most of the military's container movements, especially since COFC cars are used almost exclusively for import/export movements, which likely would be greatly disrupted in a mobilization period.

Accordingly, vans or containers should be outloaded on TOFC cars. If the movement is to a port for ocean shipment by other than RORO vessel, the use of COFC cars should be considered. However, the availability of COFC cars in the quantity desired without disrupting civilian container movements is highly improbable.

Other cars in the specialized flatcar fleet generally are assigned to specific services or to a carpool for one shipper's exclusive use. Therefore, although these cars can save blocking and bracing and should be requested when they can be employed profitably in a specific move, the likelihood of obtaining the cars is too weak to base outloading requirement on their use

TABLE 18
TRAILER TRAIN COMPANY FLEET

Trailer Train Company ownership of selected car types as contained in the April 1976 Official Railway Equipment Register. Trailer Train owns in excess of 95 percent of total US ownership of TOFC, COFC, and autorack cars.

Type	Reporting Marks	Quantity
TOFC	*TTX	29,661
	TTAX	5,033 (see also COFC cars)
	GTTX	2,287
	LTTX	1,876
	XTTX	733
	Total	39,590

Each car has a capacity of two 40-foot (nominal length) trailers. Some can handle one 40-foot and one 45-foot trailer. The XTTX cars also have the capability of transporting three 28-foot trailers.

Type	Reporting Marks	Quantity
COFC	TTAX	5,033 (see also TOFC cars)
	TTCX	708
	Total	5,741

Each car can handle four 20-foot container equivalents. Note that the TTAX cars can handle either containers or trailers and so are counted in both TOFC and COFC totals.

Type	Reporting Marks	Quantity
Bilevels	TTBX	4,333
	BTTX	2,776
	Total	7,109
Trilevels	TTKX	6,133
	RTTX	3,500
	KTTX	2,685
	TTRX	2,196
	ETTX	796
	Total	15,310

*Definitions of Trailer Train Company reporting marks (all are flatcars)
TTX - Equipped with hitches and bridge plates for the transportation of trailers.
TTAX - Equipped with movable foldaway container pedestals, knockdown hitches and bridge plates for transporting trailers or containers or combinations of both. (A = all).
GTTX - Equipped with hitches and bridge plates for the transportation of trailers built by General American Transportation Corporation. (G = general)
LTTX - Low deck (2' 8" or 2' 9" instead of 3' 6"), equipped with hitches and bridge plates. (L = low)
XTTX - Equipped with four hitches and bridge plates for the transportation of two trailers; one 45-foot and one 40-foot or three 28-foot trailers.
TTCX - Equipped with movable foldaway container pedestals for transporting containers. (C = container)
BTTX - Equipped with bilevel autoracks furnished by member railroads. (B = bilevel)
TTBX - Length 89' 4" or over, equipped with bilevel autoracks furnished by member railroads. (B = bilevel)
TTKX - Length 89' 4" or over, equipped with hinged-end trilevel autoracks furnished by member railroads.
RTTX - Length 89' 4" or over, equipped with fixed trilevel autoracks furnished by member railroads.
KTTX - Equipped with hinged-end trilevel autoracks furnished by member railroads.
TTRX - Equipped with fixed trilevel autoracks furnished by member railroads.
ETTX - Equipped with fully enclosed trilevel autoracks furnished by member railroads. (E = enclosed).

Factors affecting the use of specialized flatcars include:

1. First priority for use of general-purpose flats should be to load tracked vehicles and nonstandard wheeled vehicles; for example, artillery.

2. First priority for requesting specialized flats should be for TOFC and COFC cars to load vans and containers, which require very extensive blocking and bracing to move on general-purpose cars.

3. TOFC and COFC cars require no blocking and bracing.

4. Bilevel and trilevel flats will require heavier chains and possibly different hooks to handle other than commercial specification vehicles.

5. Chain tiedown flats may require heavier chains, depending on the loads for which they were designed.

6. Where TOFC cars must be loaded using a ramp rather than side or overhead loading, the number of cars at a ramp should be limited to about 10 because of the delay involved in backing the trailers down the length of the cars and returning with the tractor.

7. Where sufficient suitable aprons and MHE are available, it may be desirable to load containers directly onto COFC cars rather than to place them on bogies and use TOFC cars.

8. If COFC or TOFC cars are not available, some blocking and bracing time and expense can be saved by using bulkhead flatcars to carry containers.

9. Bilevel and trilevel cars require, obviously, bilevel and trilevel ramps or other equipment as indicated in TM 55-625.

10. TOFC, COFC, bilevel, and trilevel cars average 89 feet long. TOFC cars can handle two 40-foot trailers or one 40-foot and one 45-foot trailer. COFC cars can handle four 20-foot container equivalents. Autorack cars can accommodate four to seven vehicles per deck, depending on vehicle length and the number of tiedown chain sets.

11. Tracks used to store or load cars over 65 feet long should be reachable without going through curves exceeding 10-degree curvature, and tracks used for cars between 55 and 65 feet should be reachable without going through curves exceeding 12-degree curvature.

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