

D No: 2966-1-PR

Assigned to: _____

Project No: _____

Contract No: _____

Task Order No: _____

RAND DOCUMENT

SAC DISPERSAL: ESTIMATED COSTS OF
RECOVERY BASES AND HOME SHELTERS

G. P. Ward

9 June 1955
Revised 25 July 1955

This document was originally not intended for distribution outside of the RAND Corporation; however, given its historical significance, it was published openly in August 2021 after a review by RAND and any controlling U.S. government authority (if required).

For RAND Use Only

DO NOT QUOTE OR CITE IN EXTERNAL RAND PUBLICATIONS OR CORRESPONDENCE

SAC DISPERSAL: ESTIMATED COSTS OF
RECOVERY BASES AND HOME SHELTERS

Cost estimates were requested for RAND and SAC proposed SAC dispersal plans.^{1/} Below is a description of the assumptions and methodology used to develop the cost estimates (Tables I through VI) for the SAC proposed staging recovery bases, RAND proposed recovery "only" bases, and home shelters.

Staging recovery bases are emergency landing fields planned to take care of readying medium and heavy bombers for one strike of five sorties. These emergency fields would be new or ADC and ATRC bases raised to and maintained at the necessary minimum SAC standards during peacetime. The recovery "only" bases are civil airports which could accommodate aircraft that would disperse to them during an attack. The base would provide shelters for the crews and possibly minimum flyaway kits to facilitate taking off again to fly to a base which could ready them for a strike. The home shelters are for the protection of those "essential" personnel who live off the base.

STAGING RECOVERY BASES

Tables I and II present costs of staging recovery bases "new." Tables III and IV present the incremental costs of staging recovery bases which are added to the facilities of an ADC base. The costs are divided between "soft" bases and "hard" bases, and within each, vary incrementally according to the number of tankers which the base could accommodate. The "soft" base is a conventional base, whereas a "hard" base is a base which has its essential facilities blast protected.

^{1/} See "Your SAC Dispersal Cost Estimating Request," R. N. Grosse to A. Wohlstetter and F. Hoffman, 4-29-55, M-2169.

The facilities estimated by J. J. O Sullivan for an overseas refueling base^{2/} were felt to be representative of the facilities at an average staging recovery base except for adjustments for runways, aprons and fuel storage. On Tables III and IV, the minimum installations requirements for sustained operations given in "USAF Installations Facility Requirements Manual," August 1954, for 25 jet-type aircraft, fighter-interceptor squadron, nontenant, were used as the basic "typical" ADC base; all costs necessary to increase these facilities to the average staging recovery facilities were estimated. Other assumptions for all cases were that emergency maintenance would be provided by mobile maintenance units, that flyaway kits would be stored at the base and, on Tables III and IV only, that ADC would be tenant on the base.

(a) Bases Costed "New"

Runways were costed at emergency lengths of 8000 ft by 200 ft for the B-52's and 7500 ft by 150 ft for the B-47's. Parking and maintenance aprons were kept at a minimum. All pavements were costed at \$12.00 a square yard, the cost per square yard of pavement for "heavy" aircraft.

Fuel and fuel storage facilities for filling the given number of aircraft at the base to capacity plus a 25 per cent waste allowance were estimated as initial investment. This is assuming that the aircraft will be capable of one strike only from this base. War reserve has not been provided.

Costs for housekeeping, station, and unit essential equipment sets were SAC estimates. Source for the costs of the flyaway kits will be given in detail on page 9 of this report.

On the hard bases, fuel storage, flyaway kit storage, communications, operations, electrical power were placed underground, hydrants made blast

^{2/} Prepared by J. J. O'Sullivan for use by A. Wohlstetter, F. S. Hoffman, R. J. Lutz, and H. S. Rowen, "Selection and Use of Strategic Air Bases," Project RAND, April 2, 1954, R-226 (T.S.).

Table I

B-52/KC-135 STAGING RECOVERY BASES - NEW
(Value in Millions of Dollars)

	4 B-52's		Soft Base				45 B-52's		30 KC-135's		4 B-52's		Hard Base				45 B-52's		30 KC-135's	
	No Tankers		4 KC-135's		2 KC-135's		No Tankers		30 KC-135's		No Tankers		4 KC-135's		2 KC-135's		45 B-52's		30 KC-135's	
	I	A	I	A	I	A	I	A	I	A	I	A	I	A	I	A	I	A	I	A
Installations Facilities	7.606	0.380	0.537	0.027	0.269	0.013	13.113	0.656	4.029	0.201	7.782	0.389	0.608	0.031	0.332	0.016	14.535	0.727	4.652	0.232
Organizational Equip. & Stocks																				
Station Set	0.350	0.021					0.350	0.021			0.350	0.021					0.350	0.021		
Housekeeping Set	0.100	0.006					0.100	0.006			0.100	0.006					0.100	0.006		
Unit Essential Equipment	0.300	0.018					0.300	0.018			0.300	0.018					0.300	0.018		
Initial Stocks	0.102						0.102				0.102						0.102			
Spares																				
Pre-Strike Flyaway Kit	1.698		0.707		0.707		5.094		1.414		1.698		0.707		0.707		5.094		1.414	
Transportation	0.040	0.080					0.040	0.080			0.040	0.080					0.040	0.080		
Personnel																				
Pay & Allowances		0.772						0.772				0.772						0.772		
Training	0.988	0.192					0.988	0.192			0.988	0.192					0.988	0.192		
Travel	0.045	0.008					0.045	0.008			0.045	0.008					0.045	0.008		
POL																				
Bombers	0.025						0.276				0.025						0.276			
Tankers			0.016		0.008				0.123				0.016		0.008					0.123
Miscellaneous		0.025						0.025				0.025						0.025		
Services & Miscellaneous		0.088						0.088				0.088						0.088		
TOTAL	11.254	1.590	1.260	0.027	0.984	0.013	20.408	1.866	5.566	0.201	11.430	1.599	1.331	0.031	1.047	0.016	21.830	1.937	6.189	0.232

Permanent Personnel

Officers	14
Airmen	233
TOTAL	247

I = Initial investment
A = Annual Operating

Table II

B-47/KC-97 STAGING RECOVERY BASES - NEW
 Values in Millions of Dollars)

	Soft Base										Hard Base									
	5 B-47's No Tankers		2 KC-97's		1 KC-97		45 B-47's No Tankers		20 KC-97's		5 B-47's No Tankers		2 KC-97's		1 KC-97		45 B-47's No Tankers		20 KC-97's	
	I	A	I	A	I	A	I	A	I	A	I	A	I	A	I	A	I	A	I	A
Installation Facilities	6.780	0.339	0.236	0.012	0.164	0.008	10.862	0.543	2.087	0.104	6.947	0.347	0.290	0.015	0.218	0.011	11.225	0.561	2.189	0.109
Organizational Equip. & Stocks																				
Station Set	0.350	0.021					0.350	0.021			0.350	0.021					0.350	0.021		
Housekeeping Set	0.100	0.006					0.100	0.006			0.100	0.006					0.100	0.006		
Unit Essential Equipment	0.200	0.012					0.200	0.012			0.200	0.012					0.200	0.012		
Initial Stocks	0.102						0.102				0.102						0.102			
Spares																				
Pre-Strike Flyaway Kit	0.533		0.377		0.377		1.599		0.377		0.533		0.377		0.377		1.599		0.377	
Transportation	0.040	0.080					0.040	0.080			0.040	0.080					0.040	0.080		
Personnel																				
Pay & Allowances		0.772						0.772				0.772						0.772		
Training	0.988	0.192					0.988	0.192			0.988	0.192					0.988	0.192		
Travel	0.045	0.008					0.045	0.008			0.045	0.008					0.045	0.008		
POL																				
Bombers	0.011						0.099				0.011						0.099			
Tankers			0.006		0.003				0.082				0.006		0.003				0.082	
Miscellaneous		0.025						0.025				0.025						0.025		
Services & Miscellaneous		0.088						0.088				0.088						0.088		
TOTAL	9.149	1.543	0.619	0.012	0.544	0.088	14.385	1.747	2.546	0.104	9.316	1.551	0.673	0.015	0.598	0.011	14.748	1.765	2.648	0.109

Permanent Personnel

Officers	14
Airmen	233
TOTAL	247

I = Initial Investment
 A = Annual Operating

resistant, and shelters constructed for the men.

(b) Base Incremental to an ADC Base

The typical ADC airfield runway was given as 7400 ft by 150 ft. This was increased to emergency landing field requirements of 8000 ft by 200 ft for the B-52's and 7500 by 150 ft for the B-47's. Taxiways were lengthened and increased apron parking provided, although this was kept at a minimum with the idea that extra runways and other available pavement at the ADC base will be used in time of an emergency. All pavement was costed at \$7.20 a square yard, the cost per square yard of "light pavement" provided at fighter interceptor airfields and sufficient for emergency use by heavier aircraft.

The facilities for fuel storage provided enough capacity to store jet fuel for five sorties plus a 25 per cent waste allowance. It is assumed that the aviation gasoline necessary for the KC-97's own consumption would be supplied by the tank trucks included within organizational equipment. The two hydrants available at an average ADC base were considered sufficient to take care of either four B-52's or five B-47's and their tankers, except for the case when there would be four B-52's and four KC-135's on one base; in this case an additional hydrant was included. In hardening these facilities the bulk storage was placed underground at a cost of \$0.60 a gallon capacity and the hydrants blast protected at an additional cost of \$8000 a pump.

The communications facilities (specifically, a general communications building, a transmitter building, receiver building and an extension of airfield lighting) and an operations building were increased from a typical ADC base to SAC standards for the soft base case. Additions to the base included a control tower, a briefing room, troop housing for the 149 men

6-9-55

-6-

permanently based at the installations, 10,000 square feet storage space and 3,000 square feet shop space. Utilities and medical facilities were increased in accordance with the permanent personnel.

Those facilities hardened at the base included all the communications buildings, and a fire and crash station of 5,000 square feet; a 50 psi shelter to take care of 200 men was also provided.

With no information as to the type of organizational equipment necessary at the base, a cost per man obtained from Cost Analysis Section's "System Cost Estimating Equations for Jet Medium and Heavy Bomber Aircraft", D-2281, 23 June 1954 was used.

The installation increments to the soft base to accommodate tankers provide increased parking space and fuel storage. On the hard base the fuel hydrants and fuel storage were made blast resistant. Additional stocks place on the base for the tankers include fuel and installations maintenance supplies.

Jet fuel to fill the B-47's and the B-52's to capacity for the five sorties was initially placed on the base. Maintenance supplies, etc., for the 149 men permanently based at the installations, plus their subsistence is contained within the system costs.

Table III

B-52/KC-135 STAGING RECOVERY BASES INCREMENTAL TO ADC BASE
(values in millions of dollars)

	<u>Soft Base</u>								<u>Hard Base</u>							
	<u>4 B-52's</u>		<u>4 KC-135</u>		<u>2 KC-135</u>		<u>1 KC-135</u>		<u>4 B-52's</u>		<u>4 KC-135</u>		<u>2 KC-135</u>		<u>1 KC-135</u>	
	<u>I</u>	<u>A</u>	<u>I</u>	<u>A</u>	<u>I</u>	<u>A</u>	<u>I</u>	<u>A</u>	<u>I</u>	<u>A</u>	<u>I</u>	<u>A</u>	<u>I</u>	<u>A</u>	<u>I</u>	<u>A</u>
Installations	1.668	.083	.352	.018	.130	.007	.066	.003	2.037	.101	.442	.023	.171	.009	.087	.004
Organizational Equipment	.084	.005							.084	.005						
Initial Stocks	.099		.004		.002		.001		.103		.005		.002		.001	
Transportation	.013	.048							.013	.048						
Personnel																
Pay & Allowances		.474								.474						
Training	1.525	.205							1.525	.205						
Travel	.031	.005							.031	.005						
POL																
Bombers	.031								.031							
Tankers			.016		.008		.004				.016		.008		.004	
Miscellaneous		.015								.015						
Services & Miscellaneous		.053								.053						
TOTAL	3.451	.888	.372	.018	.140	.007	.071	.003	3.824	.906	.463	.023	.181	.009	.092	.004

Permanent Personnel

Airmen	131
Officers	18
TOTAL	149

I = initial investment

A = annual operating

Table IV

B-47/KC-97 STAGING RECOVERY BASES INCREMENTAL TO ADC BASE
(values in millions of dollars)

	<u>Soft Base</u>								<u>Hard Base</u>							
	<u>5 B-47's No Tankers</u>		<u>5 KC-97's</u>		<u>2 KC-97's</u>		<u>1 KC-97</u>		<u>5 B-47's No Tankers</u>		<u>5 KC-97's</u>		<u>2 KC-97's</u>		<u>1 KC-97</u>	
	<u>I</u>	<u>A</u>	<u>I</u>	<u>A</u>	<u>I</u>	<u>A</u>	<u>I</u>	<u>A</u>	<u>I</u>	<u>A</u>	<u>I</u>	<u>A</u>	<u>I</u>	<u>A</u>	<u>I</u>	<u>A</u>
Installations	1.034	.052	.294	.015	.118	.006	.059	.003	1.321	.066	.317	.016	.127	.006	.064	.003
Organizational Equipment	.086	.005							.086	.005						
Initial Stocks	.091		.004		.001		.001		.094		.004		.001		.001	
Transportation	.013	.048							.013	.048						
Personnel																
Pay & Allowances		.474								.474						
Training	1.525	.205							1.525	.205						
Travel	.031	.005							.031	.005						
POL																
Bombers	.011								.011							
Tankers			.013		.005		.003				.013		.005		.003	
Miscellaneous		.015								.015						
Services & Miscellaneous		.053								.053						
TOTAL	2.791	.857	.311	.015	.124	.006	.063	.003	3.081	.871	.334	.016	.133	.006	.068	.003

Permanent Personnel

Airmen	131
Officers	18
TOTAL	149

I = initial investment

A = annual operating

RECOVERY ONLY BASES

The RAND proposed recovery "only" bases are specified as small civil airports which can be used for a one-time emergency landing field. A request was made for the cost of (1) a shelter for 200 crew and other essential personnel, (2) minimum flyaway kits, and (3) shelter for the flyaway kits.

A 50 psi shelter, which would withstand the effects of firestorms and reduce radiation to a negligible dosage, providing 100 cubic feet per person for 200 people is estimated at \$40,000.^{3/}

The cost estimates for both a post and a pre-strike flyaway kit, one of which might be satisfactory for the base, are given for the following aircraft: one squadron of 15 B-52's, 15 KC-135's, 15 B-47's and 20 KC-97's. The items as described in SAC Manual 400-1^{4/} within a pre-strike package will be limited to those of flight line maintenance and limited armament-electronic and field maintenance capabilities. It will be able to support a group of 15 aircraft wherein each aircraft stages three times, for a support total of 45 pre-strike staging sorties. The post-strike flyaway kit package will be limited to those items required for a one-time safety-in-flight from the post-strike base which includes only airplane "general," and "certain" armament systems and electronic sets.

A flyaway kit for one squadron of B-47's was obtained from a machine tabulation^{5/} made by the Logistics Section which contains quantities and unit costs. The total estimated costs for the pre and post-strike flyaway

^{3/}Cost per occupant estimated at \$200 by Marc Peter, Jr., and J. J. O'Sullivan, "Cost Estimates of Shelters" 9 September 1954, D(L)-2434, p. 3.

^{4/}HqSAC, 'Mobility Planners' Guide Medium Bombardment and Reconnaissance Wings' SAC Manual 400-1A, June 1954.

^{5/}31.01 (193) D-153, Initial Listing, "B-47 Flyaway Kit", OCAMA.

kit was computed by Numerical Analysis. No adjustment was made to the total cost for those items which were listed but for which unit cost data was missing. Information about the other aircraft flyaway kits could not be obtained quickly for this study. For a rough estimate of the costs of these flyaway kits the costs of the B-47 pre and post-strike kits were adjusted by a ratio of the initial investment in each of the aircraft to the initial investment in the B-47, weighted by the number of aircraft in the squadrons.

According to the SAC Manual 400-1A, an area of approximately 2,075 square feet is necessary for one medium bombardment flyaway kit or KC-97 kit. And additional 425 for a total of 2500 square feet, was approximated for a B-52 or KC-135 flyaway kit. The square footage costs are for two types of structure: \$22.00 per square foot for a blaster protected shelter, or \$6.25 per square foot for a warehouse.

Table V

RECOVERY ONLY BASE

Shelter at 55 psi for 200 people \$40,000.

Post-strike flyaway kit (values in thousands of dollars).

One squadron (15) of B-52's	\$ 402
One squadron (15) of KC-135	168
One squadron of B-47's	126
One squadron of KC-97's	89

Pre-strike flyaway kit (values in thousands of dollars).

One squadron (15) of B-52's	\$1,698
One squadron (15) of KC-135's	707
One squadron of B-47's	533
One squadron of KC-97	377

Warehouse area:

B-52 and KC-135 flyaway kit at 2500 square feet per kit.

B-47 and KC-97 flyaway kit at 2075 square feet per kit.

Additional 100 square feet allowed for office space.

Unit cost: \$6.25 a square foot aboveground, \$22.00 a square foot if blast resistant.

HOME SHELTERS

Two equations are given on Table VI for home shelters; one for a 50 psi and the other for a 200 psi home shelter. These shelters are for the essential personnel living off the main, satellite, etc., base.

Two occupants per family are assumed; costs per shelter occupant are given in "Cost Estimates of Shelters" by Marc Peter Jr., J. J. O'Sullivan, D(L)-2434, 9 September 1954. The percentage of officers and airmen living off base are as follows:^{1/}

	<u>SAC</u>
Officers	
Family	23%
Off Base	<u>61%</u>
	84%
Airmen	
Family	6%
Off Base	<u>35%</u>
	41%

Table VI

HOME SHELTERS

Equation:

$$\text{Cost of home shelters (50 psi)} = \$336 P_{oe} + \$164 P_{ae}$$

$$\text{Cost of home shelters (200 psi)} = \$554 P_{oe} + \$271 P_{ae}$$

where

P_{oe} = number of essential officers

P_{ae} = number of essential airmen

^{1/}Annette Weifenbach, "Installations, Facility Requirements, and Cost Estimating Procedures," D-2197-2, Rev. 15 December 1954, p. G&H-4.