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5th Edition

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- BRITT, T. P., Jr.**
 N-1481-AF
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- BROWN, J. F.**
 R-2417-AF
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- BROWN, T. A.**
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- BRUNNER, E. D.**
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- BUCHANAN, J. L.**
 R-2896-AF
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- BUDDIN, R.**
 R-3265-AF
- BUILDER, C. H.**
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- BURKE, T. F.**
 R-2418-AF
- BURKHOLZ, G. M.**
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- BUSH, C. H.**
 R-2435-AF
- CALLERO, M.**
 R-2719-AF
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- CARDELL, N. S.**
 N-2409-AF
- CARPENTER-HUFFMAN, M. B.**
 R-1700-AF
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- CARRILLO, M. J.**
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CARTER, G. M.
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CESAR, E. M., Jr.
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CHAIKEN, J.
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CHALOUPKA, M. G.
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CHAPEL, S. W.
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CHECINSKI, M.
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CHIESA, J. R.
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CHU, D. S.
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CLARK, J. R.
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COHEN, I. K.
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COLEMAN, S. B.
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CONNORS, T. T.
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CRANE, K. W.
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CRAWFORD, G. B.
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CRAWFORD, N. W.
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CUTLER, L.
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DADANT, P. M.
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DARILEK, R. E.
 N-2227-AF
DAUBERT, V. L. J.
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DAVIS, M.
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DEAN, R. W.
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DENNIS, G.
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DEVALK, R. J.
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DEWAR, J. A.
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DEWS, E.
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DEY, P. K.
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DINNEEN, P. M.
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DON, B. W.
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DONALDSON, T. S.
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DREYFUSS, D. J.
 R-2166-AF
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DREZNER, S. M.
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DRYDEN, J. A.
 R-2196-1-AF
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DUDZINSKY, S. J., Jr.
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DUREN, R. E.
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EAST, C. B.
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EBENER, P. A.
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EDEN, R. A.
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EINSTEIN, H. A.
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ELLIS, J. W., Jr.
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EMERSON, D. E.
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 N-2244-AF
FALLON, R.
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FAUGHT, W. S.
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FELDMAN, N. E.
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FESHBACH, M.
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FINN, M. V.
 N-2211-AF
FLEISCHAUER, P. D.
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FOCH, C. B.
 R-1977/1-1-AF
FRANCISCO, C.
 N-1973-AF
FREEMAN, C. L.
 N-1976-RC/AF
FRICK, R. H.
 R-1903-AF
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FRIEDMANN, E. T.
 R-2605-DRE/AF
FUJISAKI, M. C.
 R-1702-AF
 R-1702/1-AF
FUKUYAMA, Y. F.
 R-3154-AF
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GAINES, R. S.
 R-2367-AF
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GALLEGOS, M.
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GAMMILL, R. C.
 R-2435-AF
GANDARA, A.
 R-2184/2-AF
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GANTZ, N. C.
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GARBER, T. B.
 R-2346-AF/RC
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GARDNER, P. D.
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GARFINKLE, J. B.
 N-1882-AF
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GEBMAN, J. R.
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GELMAN, H.
 R-2943-AF
 R-3111-AF
 R-3159-AF
 R-3588-AF
 R-3588/1-AF
 R-3664-AF
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GIARLA, W. D.
 R-3158-AF
GILLESPIE, K. M. S.
 R-2194-AF
GLASEMAN, S.
 R-2567-AF
 R-2831-AF
GLENNAN, T. K., Jr.
 R-3303-AF
GOELLER, B. F.
 R-3276-AF
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GOLDBERG, G. A.
 R-2436-AF
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GONZALEZ, E.
 R-2954-DOS/AF
GOTTEMÖLLER, R. E.
 R-2923-AF
 R-3340-AF
 N-1490-AF
 N-2205-AF
GOTZ, G.
 R-2541-AF
 R-3028-AF
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GRAHAM, W. B. N-2032-AF	HILAND, J. R. R-2404-AF R-2592-AF R-2592/1-AF R-3112-AF N-1495-AF N-1496-AF N-1497-AF N-1870-AF N-2203-AF	HUDSON, C., Jr. N-2227-AF	KATZ, S. R-2473-AF N-1464-1-AF
GRAUBARD, M. H. N-2090-AF		HUSCHKE, R. E. R-1763-AF R-2100-AF R-2320-AF R-2401-AF R-2404-AF R-2408-AF R-2951-AF R-3213-AF N-1478-AF N-1767-AF N-1799-AF N-1810-AF N-2457-AF	KELLEY, C. T., Jr. R-1763-AF R-1976-AF R-2639-AF R-3060-AF N-1003-AF N-1850/1-AF N-2174/1-AF N-2431-AF N-2514-AF
GREENBERG, H. R-3482-AF	HILDEBRANDT, G. G. R-2624-AF R-2665-AF N-2662-AF		KENT, G. A. R-3369-AF R-3508-AF N-2026-AF N-2038-AF N-2211-AF N-2348-1-AF N-2526-AF
GUSTAFSON, T. E. R-3036-AF	HILL, P. T. R-3303-AF	HUSCHKE, R. E., Ed. R-2139-AF	KING, W. S. N-1976-RC/AF
HALL, G. J., Jr. N-1842-AF N-1926-AF	HILLESTAD, R. J. R-2785-AF R-3336-AF N-1482-AF N-2174/1-AF	HUTZLER, W. P. R-2736-AF N-1326-1-AF N-1973-AF	KIRKWOOD, T. F. R-3276-AF R-3304-AF R-3304/1-AF R-3425-AF N-2301-AF N-2499-AF N-2549-AF
HALLIDAY, J. R-2860-AF R-2860/1-AF R-3304-AF R-3304/1-AF N-2443-AF	HODGES, J. S. N-2086-AF	ISAACSON, K. R-3389-AF R-3612-AF	KLAHR, P. R-3158-AF R-3160-AF N-1587-AF N-1854-1-AF N-1885-AF
HALVERSON, G. R-2611-1-AF	HOEHN, W. E., Jr. R-1941/1-AF R-1941/2-AF R-1941/3-AF R-2346-AF/RC R-2528-AF N-1000-AF N-1938-AF	JAMISON, L. M. R-3276-AF N-2301-AF	KLISZEWSKI, B. A. N-2001-AF
HAMMER, M. J. R-3425-AF	HOFFMAN, B. R. N-1856-AF N-2153-1-AF	JEFFERSON, D. R. N-1906-AF	KOZACZKA, F. R-2404-AF R-2610-AF N-1323-AF N-1482-AF N-2262-AF
HANUNIAN, N. N-1336-AF	HOFFMAYER, K. J. R-3112-AF R-3437-AF N-1976-RC/AF N-2223-AF	JENKINS, B. R-3302-AF	KOZAR, P. M. R-2923-AF N-1938-AF
HARMAN, A. J. R-2184/1-AF R-2184/2-AF R-2360-AF	HOLROYD, S. M. N-2661-AF	JOHNSON, A. R. R-2417-AF R-2417/1-AF/FF R-3189-AF R-3332-AF N-1891-AF N-2001-AF	KRASE, W. H. R-2408-AF
HARRIS, E. D. N-2203-AF	HOOVER, H. G. R-2639-AF N-2203-AF	JOHNSON, C. N. N-2602-AF	KRELL, B. E. N-1295-AF N-1528-AF
HAYES, J. H. R-1941/1-AF R-1941/2-AF R-1941/3-AF R-2140-AF R-2276-AF R-2276/1-AF N-1893-AF	HORN, K. P. R-3354-AF N-1174-AF N-1285-AF N-2007-AF N-2137-AF N-2174/1-AF	JOLLY, D. G. R-2436-AF R-2620-AF N-1184-AF	KRIEGER, C. N-2227-AF
HAYES-ROTH, B. N-1600-AF	HORVATH, R. E. R-1889-AF R-2226-AF R-2736-AF N-1326-1-AF	JONES, W. M. R-2047-AF R-3436-AF/A N-1022-AF N-1210-AF N-1269-AF N-2413-AF/A	LACASSE, M. L. R-2741-AF
HEDERMAN, W. F. R-1889-AF	HOSEK, S. R-2896-AF R-3202-AF N-1342-AF N-1968-AF N-1990-AF	JUNCOSA, M. L. N-2421-AF N-2422-AF	LAMAR, J. V. R-1949-AF
HENSLER, D. R-3060-AF	HOSMER, S. T. R-2410-AF R-2688-AF R-2688/1-AF R-3208-AF R-3208/1-AF R-3508-AF N-2180-AF	KAMIONSKI, M. R-3425-AF	LAMBETH, B. S. R-2183-AF R-2579-AF R-2687-AF R-3000-AF R-3550-AF N-2230-AF N-2482-AF
HESS, R. W. R-1704-AF R-3255-AF N-2283/1-AF N-2283/2-AF N-2283/3-AF N-2283/4-AF		KANTAR, P. R-1704-AF	LANEY, J. N-2227-AF
HESSE, M. A. R-2861-AF		KANOSKE-DEY, P. R-2611-1-AF	
HIEBERT, A. L. R-1979-AF R-1979/1-AF R-3046-AF N-1536-AF N-2620-AF		KANZELBERGER, M. W. N-1238-AF	
HIGGINS, J. W. R-1941/1-AF R-1941/2-AF R-1941/3-AF R-2036-AF R-2491-AF		KAPLAN, R. J. R-3276-AF R-3304-AF R-3304/1-AF N-2301-AF	

LANGER, P. F.
R-3111-AF

LARGE, J. P.
R-2194-AF
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R-2565-AF
R-3530-AF
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LARRABEE, F. S.
R-3190-AF

LAUPA, A.
N-2008-AF

LAWRENCE, M. F.
R-3336-AF

LEINWEBER, D.
R-2741-AF
N-1607-AF
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LEVIN, N. D.
R-3159-AF

LEVINE, R.
R-3436-AF/A
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LEWIS, D. E.
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LEWIS, K. N.
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LIND, J. R.
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LIPPIATT, T. F.
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LORELL, M. A.
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LOWERY, C. L.
R-2211-AF

LU, J. Y.
R-2601-AF

LUND, J. R.
R-3527-AF

MALMSTROM, L. D.
R-3269-AF

MARKS, K. E.
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MASSEY, H. G.
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MATE, J. J., Jr.
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MATYSKIELA, W. W.
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MCARTHUR, D.
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MCCALL, J. J.
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MCCARTHY, K.
N-2058-AF

MCGARVEY, D. C.
R-3089-AF

MCIVER, D. W.
R-3604/1-AF

MCNAUGHER, T. L.
R-2345-AF

MENDERSHAUSEN, H.
N-1265-AF

MICKS, W. R.
R-1941/1-AF
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MIHALKA, M. D.
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MIKOLOWSKY, W. T.
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MILLER, L. W.
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MILLER, M. D.
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MILLS, G. F.
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MOORE, N. Y.
R-2591/1-1-AF
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MOORE, S. C.
R-2429-AF
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MOOZ, W. E.
R-2963-AF
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MORGAN, F. J.
R-1977/1-1-AF

MORRIS, M. E.
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MUCKSTADT, J. A.
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MUNDIE, L. G.
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MURRAY, F. W.
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MURRAY, M. P.
R-3482-AF
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MYERS, C. J., Jr.
N-1485-AF

MYERS, D. J.
R-2994-AF

MYLROIE, L.
N-2052-AF

NARAIN, S.
R-3158-AF
R-3160-AF
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NASLUND, W. E.
R-2951-AF
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N-1671/1-AF
N-1671/2-AF
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NELSON, J. R.
R-2103-AF
R-2103/1-AF
R-2391-AF
R-2440-AF
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N-1973-AF

NEUFER, J. E.
R-2017-AF

NOGGLE, L. W.
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NOLAN, K. A.
N-2416-AF

NYLAND, F. S.
N-1629-AF

OFER, G.
R-2522-AF

ORVIS, B. R.
R-2308-AF
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R-2867-AF

PACKMAN, E. F.
N-2567-AF

PARIS, P. C.
R-1941/1-AF
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R-1941/3-AF

PARISH, A. G.
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PARKER, T. M.
R-3164-AF
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PATRICK, R. L.
N-2027-AF

PAUKER, G. J.
R-2003-AF

PAULSON, R. M.
R-1977/1-1-AF
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PEI, R. Y.
R-2736-AF
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PERRIN, S. E.
N-2747-AF

PERRY, R. L.
R-1941/1-AF
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PETERSON, J. E.
R-2860/1-AF

PETRUSCHELL, R. L.
R-3269-AF
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N-2549-AF

PHILLIPS, E. D.
R-3304-AF
R-3304/1-AF

PHILLIPS, K. E.
R-3425-AF

PINSKY, D. N-2165-AF	R-3113/1-AF R-3475-AF N-1797-AF N-1804-AF	SCHAHGALDIAN, N. R-2913-AF	N-1260-AF N-2620-AF N-2727-AF
PLATT, A. A. R-3085-AF R-3316-AF N-2227-AF	RODRIGUEZ, T. M. N-1258-AF	SCHEDER, R. A. R-3112-AF R-3430-AF R-3437-AF N-2223-AF N-2270-AF/RC	SOWIZRAL, H. A. N-1906-AF
POGGIO, E. C. R-2334-AF N-1247-AF	ROMANOFF, H. P. R-3255-AF N-2283/1-AF N-2283/2-AF N-2283/3-AF N-2283/4-AF	SCHRECKER, W. N-2227-AF	STANLEY, W. L. R-2249-AF R-2345-AF R-2831-AF R-2861-AF R-3113-AF R-3113/1-AF R-3276-AF R-3333-AF N-1850/1-AF N-2301-AF
POLICH, J. M. R-2308-AF R-2867-AF	RONFELDT, D. F. R-2997-AF/RC	SCHUTZ, C. R-2401-AF N-2551-AF	STANTON, R. E. R-3269-AF N-2087-AF
POLICH, S. M. R-2611-1-AF	ROSE, B. J. R-3021-AF N-1671/3-AF N-1831-AF	SCHWARZBACH, D. S. R-2813-AF	STEIN, D. J. R-3385-AF N-2416-AF
POLLACK, J. D. R-2907-AF R-3133-AF N-1214-1-AF	ROSEN, J. H. R-3112-AF R-3437-AF N-1462-AF N-1870-AF N-2223-AF N-2327-AF	SEARS, G. A. R-2269-1-AF	STERLING, M. J. N-2294-AF
PONOMAREFF, D. F. R-2476-AF	ROSENBERG, R. M. N-2227-AF	SHAPIRO, N. Z. R-2367-AF	STODDER, J. H. N-2058-AF
PORTER, R. E. N-1515-AF	ROSS, A. L. N-1615-AF	SHARKEY, E. H. R-2404-AF N-1228-AF	STRAUCH, R. E. N-1180-1-AF N-1450-AF N-1633-AF
POWERS, B. F. R-2736-AF N-1326-1-AF	ROSS, A. L. N-1615-AF	SHAVER, R. D. R-2346-AF/RC R-3089-AF N-1861-AF N-1872-AF N-1938-AF N-2174/1-AF	STUCKER, J. P. R-3121-AF N-2479-AF
PUSCHER, E. A. N-1530-AF	ROSTKER, B. R-1894-AF R-2017-AF	SHLAPAK, D. A. R-3436-AF/A	SUNSHINE, C. A. R-2064/1-AF
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ABSTRACTS

REPORTS

R-1700-AF MODIA: Vol. 1, Overview of a Tool for Planning the Use of Air Force Training Resources. M. B. Carpenter-Huffman. March 1977.

This report describes MODIA (a Method of Designing Instructional Alternatives), a system developed to help Air Training Command (ATC) plan technical courses. The first in a series of five reports, this one discusses MODIA's rationale, structure, and support requirements as well as the results of ATC's evaluation of its effectiveness as an aid to course planning. Technical training offers both the potential for effecting substantial improvements in training efficiency and ample opportunities to improve efficiency through redesign of courses. MODIA helps the Air Force achieve these goals by (1) systematically relating quantitative requirements for training resources to the details of course design and operation during the planning stage and (2) computerizing course design to encourage the examination of alternative designs. ATC's evaluation of MODIA showed that it does help planners design more efficient courses. Its potential value to ATC, however, hinges on management issues, which ATC is currently addressing in a follow-on evaluation. 24 pp.

R-1701-AF MODIA: Vol. 2, Options for Course Design. M. B. Carpenter-Huffman. April 1977.

This report discusses the design options incorporated in MODIA (a Method of Designing Instructional Alternatives), a system developed to help Air Training Command (ATC) plan technical courses. MODIA is a unique approach to planning that relates the use of training resources to the details of course design and operation. This report follows MODIA's design process and presents at each decision point pros and cons for each option as it affects training effectiveness and use of training resources. Although the report is directed to course planners in ATC, the options described are applicable in a wide variety of education and training settings. An overview of MODIA is given in R-1700. 160 pp. Bibliog.

R-1702-AF MODIA: Vol. 3, Operation and Design of the User Interface. M. B. Carpenter-Huffman, M. C. Fujisaki, R. A. Pyles. September 1977.

This report contains instructions for the operation of the User Interface component of MODIA (a Method of Instructional Alternatives), a system developed to help Air Training Command plan technical courses. The User Interface computer program acts as a knowledgeable assistant to course planners by eliciting their judgments about how the course should be designed. Specifically, it asks for the course objectives, teaching policy, resource characteristics, and anticipated student characteristics. The user enters these data step by step in response to questions from the computer. The program collates the information and

displays the course design in a variety of formats at intermediate steps to assist planners in analysis of the design and in preparing inputs for analysis by the cost model. The program also produces a comprehensive, internally consistent description in computer-compatible form for input to the Resource Utilization Model, which analyzes the course operation. The program is described in detail in an appendix. An overview of MODIA is given in R-1700. 63 pp.

R-1702/1-AF MODIA: Vol. 3, Operation and Design of the User Interface. Appendix. M. B. Carpenter-Huffman, M. C. Fujisaki, R. A. Pyles. April 1978.

This report contains a detailed description of the user interface computer program. 38 pp.

R-1703-AF MODIA: Vol. 4, The Resource Utilization Model. M. Gallegos. July 1977.

This report describes the Resource Utilization Model component of MODIA (a Method of Designing Instructional Alternatives), a system developed to help Air Training Command plan technical courses. The model is a computerized, discrete-event simulation of course operations for planning. It simulates resource demand, resource use, and student queuing generated by student progress through the potentially complex flow patterns of a course. Among its many options are variable or fixed rates of student progress and prespecification of resource availability by the planner or determination of resource requirements by the model. The model ascertains such items as rates of resource use, average time to graduation, points at which students must wait for resources, and average and peak student loads. Another MODIA component, described in R-1701, helps the planner generate course designs for input to the model. An overview of MODIA is given in R-1700. 105 pp.

R-1704-AF MODIA: Vol. 5, A User's Guide to the Cost Model. R. W. Hess, P. Kantar. October 1977.

This report is the fifth in a series describing RAND's MODIA planning system. MODIA (a Method of Designing Instructional Alternatives) is a system of people, computer programs, and procedures that allows the rapid specification and simulation of courses of instruction during the early design phase. This report describes MODCOM, a FORTRAN-programmed computer cost model for estimating the investment and operating costs associated with alternative Air Force resident technical training courses. The five outputs produced by the MODIA cost model summarize graduates by student type; student and staff man-years; courseware, hardware, and facility characteristics and requirements; total course costs by functional element; and total course costs by program and appropriation. (See also R-1700, R-1701, R-1702, R-1703.) 284 pp.

R-1763-AF Weather and PGMs: The Utility of an Adverse Weather Weapon in a NATO Context (U). C. T. Kelley, Jr., R. E. Huschke. May 1977. Secret.

(U) This report compares the effects of weather on the performance of air-to-surface precision-guided munitions (PGMs) with representative TV and infrared (IR) sensors and relates their performance to force effectiveness. Representative summer, fall, and winter conditions from NATO's central region were used. Average performance of the TV PGM is poor under daytime winter weather conditions, but the IR PGM is good. The relative performances are reversed under daytime summer conditions; however the difference is not as great as in winter. A scenario of a Warsaw Pact armored thrust through the Fulda Gap was used to examine (1) the increase in tactical air effectiveness due to the IR PGM; (2) the relative importance of adverse weather and night delivery capabilities; (3) the balance between NATO and Warsaw Pact air in their ability to support the ground battle; and (4) tradeoffs of equal cost munition stockpiles consisting of TV PGMs, IR PGMs, and unguided munitions. 97 pp. Ref.

R-1889-AF An Evaluation of Very Large Airplanes and Alternative Fuels. W. T. Mikolowsky, L. W. Noggle, W. F. Hederman, R. E. Horvath. December 1976.

Very large airplanes using alternative fuels are examined in the context of existing and possible future U.S. Air Force missions. Synthetic jet fuel, liquid methane, liquid hydrogen, and nuclear propulsion are the fuel alternatives selected for detailed analysis. Conceptual designs of airplanes using each of these fuels were developed, and estimates were made of their life-cycle cost and life-cycle energy consumption. Mission analyses were performed to determine the effectiveness of the alternative airplanes in strategic airlift specifically and in the station-keeping role in general. Results indicate that, for most military applications, airplanes with gross weights in excess of one million pounds promise to be superior to any contemporary airplanes in terms of cost effectiveness and energy effectiveness. From both cost and energy viewpoints, a conventional hydrocarbon jet fuel, whether manufactured from oil shale, coal, or crude oil, remains the most attractive aviation fuel for future Air Force use. The report makes policy recommendations pertaining both to alternative fuels and to advanced-technology large airplanes. It also identifies future research and development requirements. (See also R-1829.) 376 pp. Ref.

R-1889/1-AF An Evaluation of Very Large Airplanes and Alternative Fuels: Executive Summary. W. T. Mikolowsky. December 1976.

This is an executive summary of R-1889. 35 pp. Bibliog.

R-1894-AF The Relevance of Training for the Maintenance of Advanced Avionics. M. B. Carpenter-Huffman, B. Rostker. December 1976.

An examination of formal training of airmen in the career fields responsible for flight-line maintenance of advanced avionics equipment. Initial training for flight-line maintenance, training at Field Training Detachments, TAC's Task Oriented Training program, and the management of training are investigated. The study shows that in initial training there was too much emphasis on theory and not enough on

the practical knowledge and skills needed on the job. There was too little training on systems integration and troubleshooting integrated systems. To better prepare technicians for advanced avionics maintenance, formal training should teach job performance (rather than theory), should take place at the base and on the equipment the airman will be associated with, and should be interspersed with actual job experience. Training should be tailored to the needs of school personnel on training development and field evaluation of training should be lessened by having the users of trained personnel become active partners in the management of training. (See also R-2017, R-2049.) 152 pp. Ref.

R-1903-AF User's Manual for RTRAJ: A Trajectory Estimation and Simulation Program. R. H. Frick. February 1977.

This report contains operating instructions for a computer program designed to provide a best estimate of the accuracy with which the motion of a vehicle can be determined on the basis of either inertial guidance measurements or external tracking, or both. The performance of the moving vehicle is described by the estimated deviation from its nominal performance. The program, developed by and used at RAND, should prove useful in the fields of ballistic missile accuracy, range instrumentation, and navigational satellites. 72 pp.

R-1941/1-AF Strategic Mobility Alternatives for the 1980s: Vol. 1, Executive Summary (U). W. E. Hoehn, Jr., R. L. Perry, J. R. Gebman, A. A. Barbour, J. H. Hayes, J. W. Higgins, W. R. Micks, P. C. Paris. March 1977. Secret.

(U) This report discusses (1) optional ways of enhancing present and future strategic airlift forces; (2) airlift options being considered by the Air Force; (3) critical uncertainties, including the appropriate mix of outsize and oversize capacity; and (4) an incremental strategy for assessing future commitments. The authors recommend further analysis of C-5A wing problems, accelerated acquisition of spares to support higher surge ratios, resolution of some persistent CRAF difficulties, and a prompt start on work needed to support the procurement of additional outsize airlift capacity. Other important issues extend to (1) exploring with the Army ways to reduce airlift equipment lists and the feasibility of partial prepositioning of heavy but low cost items, (2) clarifying uncertainties in the C-141A stretch program, and (3) the implications of increasing crew utilization rates. The goal of such initiatives is to give the Air Force a better base for evaluating long-term airlift enhancement needs and opportunities. 23 pp.

R-1941/2-AF Strategic Mobility Alternatives for the 1980s: Vol. 2, Analysis and Conclusions (U). W. E. Hoehn, Jr., R. L. Perry, J. R. Gebman, A. A. Barbour, J. H. Hayes, J. W. Higgins, W. R. Micks, P. C. Paris. March 1977. Secret Privileged Information.

See R-1941/1 for abstract. 112 pp. Ref.

R-1941/3-AF Strategic Mobility Alternatives for the 1980s: Vol. 3, Technical Appendixes. W. E. Hoehn, Jr., R. L. Perry, J. R. Gebman, A. A. Barbour, J. H. Hayes, J. W.

Higgins, W. R. Micks, P. C. Paris. March 1977. For Official Use Only. Privileged Information.

See R-1941/1 for abstract. 214 pp. Ref.

R-1949-AF Geometric Performance of Pseudorange Navigation Satellite Systems: A Computer Program. J. V. Lamar, L. N. Rowell, J. J. Mate, Jr. July 1977.

This report describes a computer program designed to analyze aspects of the geometric performance of pseudorange navigation satellite (navsat) systems for users either on earth or in earth orbit. A navsat system includes a fleet of satellites, each with an accurate clock that transmits ephemeris, time, and other signals. These signals can be received by relatively small, inexpensive equipment, thus enabling the user to compute his position and time accurately. The NAVSTAR/Global Positioning System (GPS) is such a system, and its overall user accuracy can be broken down into two components which, when multiplied together, yield an estimate of the user's position and/or time accuracy. These two components are analyzed in this report. The first depends on the relative geometry among the navsats being employed and the user's location, and the second involves a determination of system errors. This report was prepared as part of a Project AIR FORCE study entitled "Space Warfare Issues," and should be of use to military and civilian defense analysts responsible for the design, use, and survivability of GPS and other U.S. space-related systems. 92 pp. Ref.

R-1973-AF Analytic Theory of the Effects of Atmospheric Scattering on the Current and Ionization Produced by the Compton Electrons from High-Altitude Nuclear Explosions. W. Sollfrey. October 1977.

Previous studies of scattering effects have involved either ad hoc physical assumptions or Monte Carlo techniques requiring very costly computer programs. In this new theory of scattering, a transport equation is derived that governs the evolution in time of the electron velocity distribution function from the initial Compton production distribution function under the influence of the earth's magnetic field, energy loss processes, and atmospheric scattering. This differential equation is solved analytically by an expansion to third order in the ratio of spatial spreading to velocity spreading, thus providing sufficient accuracy to cover the significant duration of the pulse. The current and ionization are then calculated as integrals over the velocity distribution function. After the integrals are carried out as far as possible, rapid computer programs are employed. Results show that scattering produces major reductions in the current. 98 pp. Ref.

R-1976-AF Quality-Quantity Tradeoffs: A Historical Analysis of Air Combat. C. T. Kelley, Jr., G. K. Smith, W. W. Matyskiela. April 1977. Not Reviewed for Public Release.

This report analyzes air combat data to understand the sensitivity of aerial combat maneuvering (ACM) engagement results to variations in fighter force sizes. It also compares this data with Lanchester's theory of combat. Southeast Asia data of F-4s vs. MiG-21s indicate that the U.S.-North Vietnamese exchange ratio—the ratio of North Vietnam

aircraft losses divided by U.S. losses—decreased somewhat as initial force ratio increased in favor of the United States. The Southeast Asia data are not well fitted by either Lanchester linear or square law or by any form between them. Analysis of Korean war data (F-86 vs. MiG-15) shows the U.S.-North Korean exchange ratio increased as initial force ratio increased in favor of the United States. The Korean data are best fitted by a form of the Lanchester law falling between the linear and square laws. Analysis of quality-quantity fighter aircraft tradeoffs should include sensitivity tests of ACM modeling in addition to sensitivity tests of variables such as missile kill probabilities. 45 pp. Ref.

R-1977/1-1-AF The Air Reserve Forces in the Total Force: Vol. I, Overview and Analytical Approach. F. J. Morgan, A. A. Barbour, R. M. Paulson, C. B. East, C. B. Foch, B. Woodfill. September 1977.

This primary task report on the study of the current Air Reserve Forces (ARF) and their relation to the total force describes the organization, equipment, manning, basing, and other characteristics of the reserve components. It also compares the relative capability of selected USAF and ARF flying units. The following specific research tasks are addressed: identify the kinds of considerations that influence force mix decisions; evaluate the available Air Force statistics on readiness and other measures of military capability; formulate an improved force structure tradeoff methodology for evaluating unit effectiveness; and analyze those organizational, manning, and resource consumption areas that could be modified to improve the efficiency of the ARF. The study concludes that the ARF today collectively constitutes a highly motivated, experienced, and generally effective augmentation to the active force. Further, the usefulness of the ARF during the 1980s and beyond could be greatly enhanced by timely recognition and resolution of equipping and manpower policy problems. (See also R-1977/2, R-1977/3, R-1977/4.) 148 pp. Ref.

R-1977/2-AF The Air Reserve Forces in the Total Force: Vol. II, Cost Analysis and Methodology. A. A. Barbour. September 1977.

This is of the basic task reports on the study of the current Air Reserve Forces (ARF) and their relation to the total force. An investigation of total force costing problems revealed that current methods of estimating the costs of active and reserve units were not sufficiently alike to permit unbiased cost comparisons across active/reserve lines. Consequently, these diverse methods were not suitable for making cost comparisons bearing on active/ARF total force issues, a basic goal of the study. Thus, a major undertaking of the study was to develop a costing approach and a set of cost factors for reserve forces that were conceptually consistent with active force practice yet could still account for the essential characteristics differentiating ARF from active forces. The methodology that emerged was incorporated into RAND's computerized force cost model (FORCE). The capability of the model to produce relevant cost estimates attests to its potential value as an analytical tool for evaluating total force mix alternatives and policy options. (See also R-1977/1, R-1977/3, R-1977/4.) 74 pp. Ref.

R-1977/3-AF The Air Reserve Forces in the Total Force: Appendix A, Derivation of the FORCE Cost Model Data Base. A. A. Barbour, A. W. Bonner. September 1977.

One of two appendixes to R-1977/2, this report deals with sources and methods used to generate data inputs required by the cost model: covering force structure, beddown, manpower, flying hours, and cost factors. 116 pp. Ref.

R-1977/4-AF The Air Reserve Forces in the Total Force: Appendix B, FORCE Cost Model Excursions. A. A. Barbour, R. M. Paulson. September 1977.

This appendix to R-1977/2 documents eight cases run with RAND's computer cost model, FORCE, which was modified to incorporate routines unique to reserve units. A total USAF database was derived, which included all of the force units of both active and reserve forces. The use of the FORCE cost model was demonstrated by a series of computer runs: (1) reduced flying for ARF "transition" (obsolescent) squadrons, (2) reduction in reserve combat support manning, (3) transfer of active squadrons to the reserve forces (four variants), (4) grade relief (to permit enlistment of more prior-service personnel), and (5) hybrid associate squadrons (combined active/reserve units). 35 pp. Ref.

R-1979-AF Advanced Composites: Electromagnetic Properties, Vulnerabilities, and Protective Measures. A. L. Hiebert. May 1977.

This report discusses a measurement and analysis program for assessing the electromagnetic (EM) properties and vulnerabilities of, and protective measures for, advanced composite materials used in the design and construction of aerospace vehicles. The main objective is to suggest areas for investigation and the kind of information needed for the compilation of a database. Six areas of investigation are discussed: advanced composite materials, structural composition, and fabrication; potential use of composite materials and structures; fundamental EM parameters of advanced composites; energy sources and environments of EM hazards; EM vulnerabilities and shielding effectiveness criteria; and protective measures. Examples of measurement techniques and/or essential data are given for each. A suggested format for cataloging the information is included. 43 pp. Ref.

R-1979/1-AF Advanced Composites: Natural Space Environment Simulation, Testing, and Analysis. A. L. Hiebert. December 1978.

This report outlines a proposed five-phase program for studying and developing a test facility for (1) simulating energy sources and temperatures in the natural space environment, (2) measuring their effects on composite materials and structures used in aerospace vehicles, and (3) developing a computer-based analysis program for assessing the vulnerability and survivability of composites over a 10-year lifetime. The author identifies composite material properties and damage mechanisms; outlines major areas of concern; and lists the technical requirements for a test facility capable of exposing composites simultaneously to selected energy sources and levels, long-term simulation, and contamination-free *in situ* measurements. Proposed levels

of energy sources encountered in the natural space environment are given for solar radiation, high- and low-energy-charged particles, and magnetospheric charging. Vacuum and temperature variations are also given. 29 pp. Ref.

R-1983-AF Global Positioning System Guidance for Tactical Cruise Missiles (U). A. F. Brewer. May 1977. Secret.

(U) Can the Global Positioning System (GPS) provide, in the presence of enemy jamming, sufficiently accurate guidance to tactical cruise missiles to permit attack of high-value fixed targets? If such guidance were feasible and cost effective, cruise missiles with a night/all-weather capability could be used, for example, to strike targets deep beyond the battle area early in a large-scale conventional war rather than risk attrition of manned penetration aircraft against robust defenses. The analysis in this report shows that the desired performance could be achieved by the mid-1980s through a modest component development program. Improvements in missile clocks and development of a specified conformal antenna are needed, as is a system engineering effort to integrate the separate components and developments. 56 pp. Ref.

R-2003-AF Military Implications of a Possible World Order Crisis in the 1980s. G. J. Pauker. November 1977.

An attempt to discern trends that may make the international environment of the 1980s different from that of the recent past and to draw conclusions concerning the military implications of those trends. The author suggests that mankind may be entering a period of increased social instability and faces the possibility of a breakdown of the global order as a result of the sharpening confrontation between the Third World and the industrial democracies and as a result of a "system overload" caused by population growth, incessant demand for energy and other natural resources, and the incapacity of obsolete forms of government to deal with the complexities of today's civilization. Because there is no precedent for U.S. military planners, it might be useful to develop doctrine, plans, weapons, and force structures suitable for the protection of U.S. interests in what could turn out to be, in the 1980s, a period of chaos and anarchy. 101 pp. Ref.

R-2017-AF Analysis of the Content of Advanced Avionics Maintenance Jobs. M. B. Carpenter-Huffman, J. E. Neuffer, B. Rostker. December 1976.

An analysis of the skills and knowledge required to maintain advanced avionics systems on the flight line to provide a basis for evaluating existing training methods and career structure. Since this information was not available from Air Force sources, the authors devised a unique data-gathering procedure. By debriefing maintenance teams as they came off the job, the authors were able to describe in detail the flow of specific job steps. Analysis of these data revealed the importance for job performance of knowledge of the way components of specific avionics systems are tied together (system integration) and the unimportance of knowledge of electronic principles. Thus, training should stress system integration and be specific to particular models of aircraft. These conclusions provided the basis

for evaluation and redesign of training. (See also R-1894, R-2049.) 239 pp.

R-2036-AF The Scatterable Mine as an Air Force Munition: Inferences from Mining Experience (U). E. Dews, T. T. Connors, J. W. Higgins, J. K. Walker, Jr. August 1978. Secret NOFORN WNINTEL.

(U) This report examines combat experience with land mines in World War II, Korea, Southeast Asia, and the Mideast to draw lessons for the efficient use of the scatterable mines that will soon enter the Air Force inventory. Conventional buried mines were effective tank killers; indirect payoffs, though harder to quantify, have often been even more important. The enemy's use of mines against U.S. armor was particularly successful in Korea and Vietnam, where he could emplace mines in rear areas, remine cleared fields, and distribute the mining effort so that tanks were at risk wherever they moved. Employment doctrines are needed that will give the Air Force a similar capability with its scatterable mines. Implications for hardware development include the need for types of mines that are effective on roads, as well as against cross-country movements, and for dispensers that exploit the full capabilities of the mines and the delivery aircraft. 78 pp. Bibliog.

R-2047-AF Crisis Support Requirements for the National Command Authorities: The Limited Nuclear Options Case. W. M. Jones. June 1977. Not Reviewed for Public Release.

The behavior of the National Command Authority (NCA) is studied in situations where the imminent limited use of nuclear weapons is contemplated. The focus is on support requirements for the military command structure, which must be prepared to assist the NCA's extensive search for situation information, to rapidly develop and evaluate the possibilities and likely consequences of a wide range of alternative military operations and to use a command and control system that permits the selected operations to be undertaken, monitored, and terminated or altered at any time. 29 pp.

R-2049-AF A Proposed Course for Avionics Technicians. R. E. Duren. December 1976.

One of a series of three reports examining personnel and training support for advanced avionics systems, this report describes an initial training course which would better prepare airmen to maintain avionics equipment on the flight line. The course is significantly different from the current training course. It is given by and at a Field Training Detachment at the airbase to which an airman is assigned; training is on the specific avionics equipment to be maintained; only material relevant to actual tasks is given; and the importance of a "block diagram" understanding of the avionics system (as opposed to a basic electronics understanding) is emphasized. 25 pp. Ref.

R-2064/1-AF Interprocess Communication Extensions for the UNIX Operating System: I. Design Considerations. C. A. Sunshine. June 1977.

The UNIX operating system for the PDP-11 series of mini-computers has gained wide popularity in academic and

government circles. This report considers interprocess communication (IPC) facilities with the goal of developing an improved IPC capability for UNIX. An outline of the major issues involved in providing IPC is developed based on a survey of the literature, and UNIX IPC facilities are described in terms of that outline. By considering new applications being developed under UNIX, several shortcomings in the standard IPC facilities are identified, including the inability of "unrelated" processes to communicate, the inability to wait for multiple inputs, and primitive synchronization facilities. Techniques to provide desirable improvements are suggested, including named ports, message ports, improved signals, and message facilities. Ports appear to have the highest benefit/cost ratio, and their implementation is described in a companion report, R-2064/2. 31 pp. Ref.

R-2064/2-AF Interprocess Communication Extensions for the UNIX Operating System: II. Implementation. J. S. Zucker. June 1977.

The UNIX operating system for the PDP-11 series of mini-computers has gained wide popularity in academic and government circles. This report considers interprocess communication (IPC) facilities with the goal of developing an improved IPC capability for UNIX. A companion report outlines the major issues involved in providing IPC, describes the standard UNIX IPC facilities, and points out several of their weaknesses. The present report describes the "port" mechanism developed at RAND to overcome some of those weaknesses. It presents details of the implementation as well as sufficient background material to enable the UNIX programmer to understand how ports work and how to use them. (See also R-2064/1.) 19 pp. Ref.

R-2098-AF Introduction to the USAF Total Force Cost Model. H. G. Massey. June 1977.

Designed to produce time-phased total manpower and dollar requirement estimates for 15-year projections of alternative future USAF force and support structures, the USAF Total Force Cost Model—sometimes referred to as the FORCE model—is currently operating on computers in the Air Staff Cost and Economic Analysis Division, Directorate of Management Analysis, Comptroller of the Air Force. This report presents an overview of the model, including its basic purposes and its relationship to the planning and programming process. Some examples and suggested applications are presented. Only the general features of the model and the methodology it employs are discussed. The FORCE model has potential for application in analysis of future forces for research and development planning; studies of alternative weapon systems for mission-oriented subsets of the force; and analysis of alternative future basing plans, training structure, or other support issues. 58 pp.

R-2100-AF The Military Utility of Meteorological Satellites: An Assessment for the Mid-1980s (U). R. E. Huschke. March 1978. Secret.

(U) The utility of DMSP (Defense Meteorological Satellite Program) satellites is evaluated across the total conflict spectrum. The method is basically an analysis of weather

service supply and demand, with and without DMSP. Utility is quantified by aggregating estimates of DMSP importance, as of the mid-1980s, to a broad selection of U.S. military force and mission elements. Results are presented in three forms: (1) the potential DMSP contribution to total weather service capability at each conflict level, (2) the utility of DMSP at each conflict level relative to its peacetime utility, and (3) the relative contribution of DMSP to the major types of military forces at each conflict level. Because a large fraction of DMSP utility depends on ground-based data processing, the potential effects of the loss (to conflict) of the Air Force Global Weather Central are also evaluated. 103 pp. Ref.

R-2103-AF Life-Cycle Analysis of Aircraft Turbine Engines. J. R. Nelson. November 1977.

Presents a methodology enabling the weapon-system planner to acquire early visibility of cost magnitudes, proportions, and trends associated with a new engine's life cycle, and to identify "drivers" that increase cost and can have the effect of lowering capability. Later in the life cycle, logistics managers can use the methodology and the feedback it produces for more effective system management. The procedure followed was to develop a theoretical framework for each phase of the life cycle; to collect and analyze data for each phase; to develop parametric cost-estimating relationships (CERs) for each phase; to use the CERs in examples to ascertain behavior and obtain insights into cost magnitudes, proportions, and trends, and to identify cost-drivers and their effects; and to examine commercial experience for cost data and operational and maintenance practices that could be profitable for the Air Force. 108 pp. Ref.

R-2103/1-AF Life-Cycle Analysis of Aircraft Turbine Engines: Executive Summary. J. R. Nelson. March 1977.

Presents a methodology for life-cycle analysis of aircraft turbine engines that weapon-system planners can use to estimate certain performance/schedule/cost tradeoffs early in the design and selection phase of acquiring this important subsystem. Prompted by the steadily escalating costs of engine acquisition and ownership, the study finds that engine life-cycle costs are much larger than and different from what had previously been realized. For example, depot costs alone will exceed procurement costs for a new engine with an operational lifespan of 15 years. Ownership-data availability being the most serious obstacle, the study recommends that the Air Force begin collecting and preserving disaggregated, homogeneous, longitudinal data at both depots and bases, associated with specific engine types. The findings also suggest numerous improvements in operational and maintenance procedures that the Air Force could adopt in the near term (the Air Force has already initiated studies in some of these areas). 47 pp. Ref.

R-2117-AF An Analysis of a Proliferated Military Communication Satellite System (U). E. Bedrosian. April 1977. Confidential.

(U) This report documents RAND's participation in the Survivability Analysis Group at the Space and Missile Systems Organization. The purpose of the group was to evalu-

ate various alternatives by which the physical survivability of a proposed AFSATCOM II system could be enhanced. A representative system embodying the proliferation approach to survivability and consisting of 99 satellites, each in its own circular orbit at 10,000 n mi altitude, is used as the basis for the analysis. An orbital emplacement technique based on nodal regression is developed to permit individual orbit planes to be attained economically. Also, the system coverage characteristics are analyzed both theoretically and by computer simulation. It is shown that coverage continues to be adequate even when only a few satellites remain and that messages traverse the network relatively quickly. The worst case studied probably constitutes the break point below which only a courier mode of transmission would remain. 109 pp. Ref.

R-2139-AF Proceedings of the Target Acquisition Symposium, Ft. Belvoir, Virginia, June 8-9, 1976. R. E. Huschke, Editor. June 1977. Not Reviewed for Public Release.

The papers presented at this symposium dealt with the subjects of field measurement programs for electro-optical sensors, atmospheric measurements and models, weather effects on sensor systems, sensor performance modeling, target signatures, and search problems. This report summarizes the general discussion session by means of excerpted quotation. The participants emphasized the perceived need for greater interaction among the R&D, procurement, and operational communities on the subject of tactical target acquisition. 374 pp. Ref.

R-2140-AF How the Soviet Ground Forces Would Fight a European War: Proceedings of a Workshop Held at The RAND Corporation, 19-20 May 1976 (U). J. H. Hayes, H. A. Einstein, M. G. Weiner. July 1977. Secret Intelligence Information.

(U) This report documents six presentations and the accompanying discussions from a workshop entitled "How the Soviets Plan To Go to War." The purpose of the workshop was to exchange views—supported by evidence from the Soviet literature, doctrinal manuals, and exercises—on how the Soviets might organize, move, employ, and control their ground forces in offensive operations against NATO's Central Region. The principal aims were to identify differences in these views and the possible reasons for them, highlight issues of importance for further examination, and consider the implications of the various views relative to ways in which Soviet capabilities are represented in U.S. defense planning and analyses. Although emphasis was placed on ground force operations, some aspects of air operations, nuclear operations, and chemical operations were also discussed. 229 pp.

R-2154-AF The Soviet Strategic Culture: Implications for Limited Nuclear Operations. J. L. Snyder. September 1977.

This report identifies several historical, institutional, and political factors that have given rise to a uniquely Soviet approach to strategic thought. American doctrines of limited nuclear war and intrawar deterrence are examined in light of this Soviet doctrinal tradition. It is argued that such doc-

trines conflict with deeply-rooted Soviet beliefs; hence, Soviet decisionmakers may not abide by American notions of mutual restraint in the choice of targets and weapons. Three caveats are stressed: (1) Evidence on Soviet strategic doctrine is ambiguous. (2) Even deeply-rooted doctrinal beliefs may change, albeit slowly, in response to technical or other environmental changes. (3) Doctrinal preference is not the only important factor that might affect Soviet behavior in a nuclear crisis. Situational temptations and constraints may carry independent weight. 40 pp. Ref.

R-2163-AF Soviet Training and Tactics for Air-to-Air Combat (U). B.S. Lambeth. September 1977. Secret NOFORN WNINTEL.

(U) The Soviet Union maintains a large number of tactical fighters with primary air-to-air responsibilities. The practical effectiveness of this force, however, is a function not only of its size and sophistication but also of such qualitative factors as employment doctrine and aircrew proficiency. This study examines how the Soviet air-superiority fighter pilot is trained, how skillfully he flies, what sort of tactics he may employ in combat, and how his mission fits into the overall Soviet concept of theater warfare. Specific aspects of the Soviet air-to-air threat are noted, and several of their implications for USAF aircrew training and tactics are discussed. 70 pp. Ref.

R-2166-AF Bunched Launch, Bunched Acquisition, and Work-Arounds: Elements of Alternative Spacecraft Acquisition Policies. B.W. Augenstein, D.J. Dreyfuss, A. G. Parish. October 1979.

Spacecraft acquisition policy is reviewed to determine whether, and to what degree, variations in acquisition methods can lower total space system costs without loss of operational capability. The authors conclude that there is an alternative to the conventional acquisition strategy that would involve changes both in the conventional procurement process and in the conventional launch process. This alternative decreases system costs while increasing operational capability, and it is equally useful with either an expendable booster or a Space Transportation System recoverable booster used for launch. The concept would call for bunched launch (launching the total mission-required spacecraft in as short a time as possible) and bunched procurement (buying the total number of satellites needed at one time). The alternative strategy would require accommodations to institutional constraints and the present legal and regulatory framework. 64 pp.

R-2172-AF Emergent Nationality Problems in the USSR. J. R. Azrael. September 1977.

This report analyzes emergent ethnodemographic and ethnopollitical trends in the USSR and discusses their economic, military, and political implications for the Soviet regime and for the West. There is a large disparity between the population growth rates of the country's "European" (Slavic and Baltic) nationalities, which are low and have steadily fallen, and the growth rates of its "non-European" (Caucasian and Central Asian) nationalities, which are extremely high. As a consequence, by the end of the century, between 20 and 25 percent of its teenagers and young adults

will be "non-Europeans," of whom the vast majority will be Muslim Central Asians. 33 pp. Ref.

R-2178-AF Shrinking International Airspace as a Problem for Future Air Movements—A Briefing. P. M. Dandant. January 1978.

Explores possible effects on U.S. Air Force fighter deployments and airlift of changes in U.S. overseas basing and overflight rights, in perceptions by coastal nations of their offshore rights, and in worldwide anti-air and antiship capabilities. Examines flight times and tanker requirements in hypothetical "pure" cases involving the use of only U.S.-owned bases and a base at the final destination, together with the implications of several enroute alternatives variously calling for the avoidance of overflying Communist countries or the land, territorial waters (especially straits), or exclusive economic zones of third countries. Suggests technical and diplomatic approaches toward alleviating the problem. 22 pp.

R-2184/1-AF Peacetime Adequacy of the Lower Tiers of the Defense Industrial Base. G. G. Baumbusch, A. J. Harman. November 1977.

Have the lower tiers of the U.S. domestic defense industrial base—that is, the subcontractors and suppliers—become inadequate to meet the needs of the Department of Defense (DOD)? This study examines the issue of lower-tier peacetime adequacy in terms of (1) the possibility of too few suppliers; (2) the ways in which the conduct of DOD business may be influencing suppliers to leave or stay in government business; (3) how DOD buying practices affect the efficiency of weapon systems acquisition; and (4) how the DOD, Congress, and courts interact in policymaking decisions that affect the adequacy and efficiency of the lower tiers. To compile data for the analysis, 13 system program offices were surveyed at two Air Force product divisions: Aeronautical Systems Division and the Space and Missile Systems Organization. Four communication satellite programs, two missile programs, and seven aircraft programs were included in the study. Based on the results of the survey, the authors conclude that fears about peacetime erosion of the industrial base are largely unfounded, but some buying practices do increase costs. (See also R-2184/2.) 86 pp. Bibliog.

R-2184/2-AF Appendixes to the Report on the Peacetime Adequacy of the Lower Tiers of the Defense Industrial Base: Case Studies of Major Systems. G. G. Baumbusch, A. J. Harman, D. J. Dreyfuss, A. Gandara. November 1977.

This companion volume to R-2184/1 presents the case studies derived from a survey of 13 system program offices at two Air Force product divisions: Aeronautical Systems Division and the Space and Missile Systems Organization. Included in the survey were seven aircraft programs, two missile programs, and four communication satellite programs. The case studies are organized under four major topics: Aircraft, Maverick, SRAM, and Spacecraft. 85 pp.

R-2194-AF A Critique of Aircraft Airframe Cost Models. J. P. Large, K. M. S. Gillespie. September 1977.

Examines a sample of seven aircraft airframe cost models: three RAND models published sequentially from 1966 to 1976; one developed by Planning Research Corporation in 1965 and revised in 1967; two from J. Watson Noah Associates (1973 and 1977); and a transport aircraft model from Science Applications, Inc. (1977). The intent is to determine whether the model output is reasonable over a broad range of inputs, what limitations should be noted, and where one model might be preferable to the others. The critique shows that all the models have some deficiencies and all should be used with caution. The more recent models appear to be better than the older ones, which may be taken as a sign of progress, but it is plain that more progress is needed. Some of the lessons learned in this review may be helpful in pointing out how the next generation of aircraft airframe cost models could be improved. 51 pp. Ref.

R-2196-1-AF A Critique of Spacecraft Cost Models. J. A. Dryden, J. P. Large. September 1977.

Examines the estimation accuracy of a group of parametric cost models used for a variety of spacecraft. For two major reasons, it reinforces the caveat of model builders that models should not be used mechanically but should reflect changing spacecraft characteristics: (1) weight, the most widely used independent variable, should be less constraining in the next generation of spacecraft with space-shuttle launching; and (2) spacecraft are becoming cheaper on a per-unit-of-performance basis. In estimating nonrecurring costs, none of the models are generally applicable to any subsystem except structure, but several SAMSO models are useful for estimating total nonrecurring cost. All the models do better in estimating recurring costs. The SAMSO models appear most reliable for the user who lacks detailed knowledge of a program and wishes to base an estimate on such characteristics as weight and maximum array output. 75 pp. Bibliog.

R-2211-AF Estimation Techniques and Other Work on Image Correlation. J. A. Ratkovic, F. W. Blackwell, H. H. Bailey, C. L. Lowery. September 1977.

Image correlation, or "map matching," has important implications for autonomous target acquisition and terminal guidance for various missiles, as well as for other pattern recognition applications. This report makes the following contributions to image correlation: (1) analysis of block-substitution effects (snow, shadows, clouds, and the like) on the probability of correlation, P_c ; (2) development of a closed-form approximation for computing P_c ; (3) new techniques for calculating the inherent scene characteristics (numbers of independent elements in the scene and the scene correlation length); (4) a completely new procedure for estimating the value of P_c from the correlation data themselves, and (5) a new technique for selecting and locating the significant features in a scene. 71 pp. Ref.

R-2218-AF Fatality Uncertainties in Limited Nuclear War. B. W. Bennett. November 1977.

Presents counterarguments to the article "Limited Nuclear War," by S. D. Drell and F. von Hippel, *Scientific American*, November 1976. The article concludes that any Soviet limited counterforce attack, if strategically effective, would

inflict very high fatality levels; and because the USSR is not pondering such attacks, the United States should not inflame the situation by building up flexible counterforce capabilities as recommended by Secretary of Defense Schlesinger in 1974. The report argues that Drell and von Hippel neglect the importance of the assumptions underlying attack scenarios and the wide-ranging effects of uncertainty on fatality calculations. Using RAND's new SNAPPER model for assessing nuclear damage, the report concludes that the USSR could launch potentially effective limited counterforce attacks while causing only a one to three million U.S. fatalities, exactly the range suggested by Schlesinger. It therefore would be unwise to dismiss such attacks from the realm of possibility. 20 pp. Ref.

R-2226-AF The Decisionmaker's Workbook for Estimating Minimum Aerial Tanker Requirements (U). W. T. Mikolowsky, R. E. Horvath. May 1978. Secret NOFORN WNINTEL Privileged Information.

(U) Presents a series of rules of thumb for estimating total minimum U.S. tanker requirements for aerial refueling. All current tanker uses are considered, including support of the SIOP and military airlift. No specific estimate of the number of tankers required is derived. Rather, the user is provided worksheets for generating his own estimates based on his own assumptions—within the limits of the report. An illustrative scenario demonstrates the use of the method and worksheets. The workbook is meant to be used for overall policy guidance and for examining tradeoffs of tanker use; it is not intended for detailed operational planning. 102 pp. Ref.

R-2230-1-AF Potential Vulnerabilities of the Warsaw Pact Tactical Rear: A Briefing (U). D. E. Lewis, R. L. Blachly, C. B. East, G. F. Mills, R. A. Wise. December 1977. Secret.

(U) Examines options and payoffs for disrupting a Warsaw Pact offensive against NATO by destroying or impeding critical sustaining elements and second echelon forces in the Pact's tactical rear area. The approach used is a map exercise identifying possible defensive positions for the U.S. V Corps and positioning a Soviet tank army in various arrays under three scenarios, each representing a different rate of advance of the attacking army. The report explores the Pact's dependence on rear-area support over time and over changes in combat activities and conflict types, and identifies potential vulnerabilities in the Soviet tactical rear area in the early phases of each of the three scenarios investigated. 41 pp. Ref.

R-2232-AF Potential Vulnerabilities of the Warsaw Pact Tactical Rear: Methodology and Input Data (U). D. E. Lewis, R. L. Blachly, L. Cutler, C. B. East, G. F. Mills, R. A. Wise. October 1978. Secret NOFORN WNINTEL.

(U) Provides the basic methodology and specific data inputs used in a study conducted for the purpose of identifying potential vulnerabilities within the tactical rear area of a Warsaw Pact tank army attacking a U.S.-defended sector in the Central NATO region. Three rates of advance were allowed the Warsaw Pact forces, reflecting three levels of U.S. defensive capability and, thus, three levels of material

consumption by the Pact forces. A map exercise technique was employed to handle the detailed interactions of the attacking Pact divisions and defending U.S. division. Map exercise moves were entered into the Map Exercise Computer Assistance (MECA) processor, a computer program developed concurrently to support the map exercise technique. MECA stored force structure data and logistics data, calculated attrition and consumption of supplies, recorded the operation of the Warsaw Pact supply system, computed the traffic burden on LOCS, and reported unit status over time. (See also R-2230-1, R-2233.) 113 pp. Ref.

R-2233-AF Potential Vulnerabilities of the Warsaw Pact Tactical Rear: Analysis and Results (U). D. E. Lewis, R. L. Blachly, C. B. East, G. F. Mills, R. A. Wise. February 1979. Secret NOFORN WNINTEL.

(U) The present report in the series addresses two questions: (1) Can we identify particular activities in the Warsaw Pact tactical rear area that are crucial for mounting or sustaining a large-scale conventional Pact attack in Central Europe? (2) If there are such activities, when do they occur and what are their characteristics and vulnerabilities? (See also R-2230-1, R-2232.) 77 pp. Ref.

R-2243-AF Estimated Costs of Extended Low-Rate Airframe Production. D. J. Dreyfuss, J. P. Large. March 1978.

Achieving a high rate of production as quickly as possible has traditionally been viewed as the most effective way of satisfying time-urgent inventory requirements while keeping production costs low. One common consequence has been the delivery of less than fully qualified production articles. This report discusses the cost of extending initial low-rate production while tests of early production articles continue. The relatively small resultant cost increases can potentially be offset by the delivery of more capable production items, lessened needs for postdelivery modification or retrofit, and lower total-life system costs. 61 pp.

R-2249-AF Measuring Technological Change in Jet Fighter Aircraft. W. L. Stanley, M. D. Miller. September 1979.

Develops technique to characterize level of and change in jet fighter air vehicle technology. It complements other methods used to assess technological risks of new fighter concepts and to compare U.S. and foreign fighter technology. The technique uses multiple regression to relate time of appearance of an aircraft design to its level of technology. Resulting expressions measure performance consequences of technological advance in terms of such parameters as specific power, sustained load factor, Breguet range, and payload fraction. Measured in these terms, the rate of advance of U.S. fighter air vehicle technology is declining. The monetary cost of increasing the rate of advance could be very high. In the future, designers will have to balance increasingly difficult improvements in air vehicle technology against improvements in other technologies (such as avionics or armament) that also enhance combat effectiveness. 111 pp. Ref.

R-2264-AF Reliability Improvement Warranties for Military Procurement. A. Gandara, M. D. Rich. December 1977.

Examines the Reliability Improvement Warranty (RIW). Consumer and commercial warranty experience does not alone justify optimistic expectations for RIWs; the effect of RIWs in completed Department of Defense (DOD) programs is inconclusive; and as a result of inadequate research design the expectation of drawing meaningful conclusions from the ongoing RIW experiment may be over-optimistic. Examination of completed RIW programs, however, suggests the importance of (1) modification after operational use or testing, (2) schedule flexibility, (3) contractor involvement in initial overhaul and repair, and (4) avoidance of RIWs in programs subject to extreme quantity or utilization uncertainty. The design of the DOD's ongoing RIW experiment can be improved by (1) reducing the variation in contractual terms, (2) developing better controlled conditions, and (3) establishing defined limits for the experiment. In addition, the DOD must recognize the multiple objectives of the RIW and establish priority among them to facilitate evaluation. 56 pp.

R-2265-1-AF Target Areas Accessible to the TRIM Weapon System (U). L. N. Rowell. March 1978. Secret.

(U) Discussion and illustrations of the range of geographical areas which could be struck by an advanced weapon system. Seventeen figures are included. 35 pp. Ref.

R-2269-1-AF The TRIM Weapon System Concept: A Briefing (U). G. A. Sears. March 1978. Secret.

(U) Documentation of a briefing on the preliminary assessment of a promising new weapon system concept. (See also R-2265.) 25 pp.

R-2276-AF The Evolution of Military Officer Personnel Management Policies: A Preliminary Study with Parallels from Industry. J. H. Hayes. August 1978.

A perspective on the debate over personnel and compensation policies, documenting the evolution of military officer personnel management policies from Colonial times to the present. Emphasis is placed on the provision of the "required" number of properly trained officers during both war and peace. The historical development of a managerial class in industry is also examined, partially because personnel practices of business firms have been held up as examples of efficiency for the services. This is shown to have little basis in fact. The evolution of the military officer and his counterpart in industry is traced through six historical periods. 202 pp. Bibliog.

R-2276/1-AF The Evolution of Military Officer Personnel Management Policies: A Preliminary Study with Parallels from Industry—Executive Summary. J. H. Hayes. August 1978.

The discussion in the main study is arranged by historical period, whereas this executive summary is organized around personnel management problems as they have emerged both for the military officer and the manager in industry during the history of the United States. 22 pp.

R-2281-AF Measuring Industrial Adequacy for a Surge in Military Demand: An Input-Output Approach. M. D. Miller. September 1978.

A major concern of the Department of Defense (DOD) is the ability of industry to respond successfully to the surge demand for its output that might accompany direct or indirect U.S. involvement in an international crisis. This report provides a detailed description of a methodology, based on input-output analysis, which can be used to measure the effect on interindustry shipments of various hypothetical increases in DOD purchases of crucial combat materiel. By combining these effects with sector output data, it is possible to isolate those lower-tier supplier sectors which appear potentially most vulnerable in terms of needing to devote a "large" percent of their total production capability to meet the surge. Finally, by comparing these potential vulnerabilities with published capacity utilization rates, a crude estimate is obtained of each supplier sector's ability to respond to surge demands. (See also R-2360.) 80 pp. Bibliog.

R-2287-AF An Appraisal of Models Used in Life Cycle Cost Estimation for USAF Aircraft Systems. K. E. Marks, H. G. Massey, B. D. Bradley. October 1978.

Although life cycle analysis is widely used as a management tool, considerable uncertainty still exists about its effectiveness with respect to economic tradeoffs, funding decisions, and resource allocations. This report evaluates some of the most widely used life cycle cost models: AFR 173-10 models (BACE and CACE); the Logistics Support Cost model; the Logistics Composite model; the MOD-METRIC model; AFM 26-3 Manpower Standards; Air Force Logistics Command Depot Maintenance Cost Equations; the DAPCA model; and the PRICE model. The models are rated within a framework incorporating a set of cycle cost elements and a set of cost driving factors. Color-coded illustrations summarize the results. The models are shown to have many shortcomings that limit their usefulness for life cycle analyses in which estimates of absolute, incremental cost are required. Specific areas are identified where driving factor/cost element combinations are not adequately addressed. 111 pp.

R-2308-AF Alcohol Problems: Patterns and Prevalence in the U.S. Air Force. J. M. Polich, B. R. Orvis. June 1979.

Examines the nature and extent of alcohol-related problems among Air Force and comparable populations, based on special surveys, official records, and alcoholic beverage sales data. Two distinct types of alcohol problems are identified: alcohol dependence, a severe and chronic condition linked to alcoholism; and adverse effects of alcohol, such as health impairment, decreased productivity, or social disruption. 13.9 percent of Air Force personnel are estimated to be affected, with 4.6 percent among these classified as dependent. Results show that the patterns and rates of alcohol problems in the military services are similar to those found in comparable civilian groups. The analysis isolates important behavioral risk factors, such as frequent heavy drinking, intoxication, and social warnings, that may be used as precursory signals of more serious problems. 185 pp. Bibliog.

R-2320-AF Effect of Weather on Near-Term Battlefield Air Support in NATO: Weather and Warplanes VII (U). R. E. Huschke. October 1978. Confidential.

(U) Quantification of the effect of weather on visual target acquisition for the specific aircraft-munition combinations and low-level tactics that the Air Force may use in a major mission against Warsaw Pact armor in a NATO war. First, a minimum range at which the target must be detected (the minimum conversion range) is determined. It is a function of target, munition, and aircraft characteristics, not of weather. Then—to answer the question "How often do weather conditions allow sufficient visual contrast transmission to assure detection ranges at least as great as the minimum conversion range?"—contrast transmission occurrence frequencies were calculated as a function of time of year, time of day, and range to target. 45 pp. Ref.

R-2334-AF Forecasting Processing Requirements of Standard USAF Base Level Computer Systems. E. C. Poggio, N. L. Ainslie. July 1978.

Develops a methodology for forecasting computer requirements to support functional systems that are operational at the time of forecasting. The approach is to develop regression models that can relate past base characteristics to past computer requirements, so that one can then employ estimates of future base characteristics, as obtained from planning documents, to predict future workload. Although originally developed within the context of the Burroughs 3500, the methodology should be useful for estimating, for any computer system, the effects on the processing requirements of activity changes within the Air Force and of organizational and basing options that the Air Force may consider. It can also be used for predicting the processing requirements of such alternatives as a regional or central system, which, the report finds, may well yield large benefits. 116 pp.

R-2345-AF The Use of Prototypes in Weapon System Development. G. K. Smith, A. A. Barbour, T. L. McNaughton, M. D. Rich, W. L. Stanley. March 1981.

This study examines the role of prototypes in the contemporary environment of weapon system acquisition. The research draws on case studies of four systems (two Air Force airplanes and two Army helicopters) that were developed in the early 1970s and that used prototypes in various ways. These were compared with a broad range of acquisition programs that used other acquisition strategies. The objective of the study is to sharpen the understanding of advantages and disadvantages of prototyping and conditions under which its use may be advantageous. Section II presents an outline of the different kinds of prototypes, and the various objectives that might be sought in a prototype phase. The section concludes with a description of the analysis procedure, a summary of the four systems examined, and the source of data on nonprototype programs used for comparison. Section III summarizes the results of the research, and Sec. IV contains the conclusions. Four appendixes are attached, each describing one of the case studies. 181 pp.

R-2346-AF/RC Perspectives on U.S. and Soviet Counterforce Capabilities and SALT (U). W. E. Hoehn, Jr., D. B. Rice, B. W. Bennett, C. H. Builder, T. B. Garber, R. D. Shaver, H. L. Shulman. July 1978. Secret Formerly Restricted Data.

(U) Summarizes, in the form of a briefing, the principal findings from a number of separate RAND research projects in the strategic area conducted for various Department of Defense sponsors in recent years. The briefing is organized around a set of six questions: (1) Is Minuteman becoming vulnerable to Soviet attack? (2) Would the collateral damage from a comprehensive Soviet attack on U.S. strategic forces make it indistinguishable from an all-out attack? (3) Does the United States now threaten Soviet silos? (4) Are U.S. developments leading inexorably to this capability? (5) Could the United States develop such a threat, if desired? (6) Could treaty limitations now under discussion forestall such counterforce threats? 29 pp.

R-2360-AF Defense Industrial Planning for a Surge in Military Demand. G. G. Baumbusch, P. D. Fleischauer, A. J. Harman, M. D. Miller. September 1978.

Analyzes the capability of the lower tiers (the subcontractors and suppliers) of the industrial base to surge production of defense-related output in time of crisis. Industrial Preparedness Planning (IPP) currently used by the Department of Defense (DOD) to measure and plan industrial capability is ineffective. A more productive approach would involve (1) surge demand analysis, (2) lower tier industrial activity overview, and (3) collection and analysis of data on potentially critical industries. This overview indicates that the lower tiers could significantly increase production of defense-related output in a year. Nonferrous forgings, semiconductors, and optical instruments were investigated using a data-gathering instrument that DOD could adopt as the third step in this new approach. In these industries current defense producers could double their defense-related output in a year's time and noncurrent defense producers could undertake some defense production within six months. The most critical determinants of the feasibility of surge are the availability of labor and capital, particularly skilled labor. 102 pp.

R-2367-AF The MH Message Handling System: User's Manual. B. S. Borden, R. S. Gaines, N. Z. Shapiro. November 1979.

A detailed description of MH, a message handling system built on the UNIX time-sharing system that enables users to compose, send, receive, store, retrieve, forward, and reply to messages. The design of MH is based on a different approach than is usually used for large systems. The command interface to MH is the UNIX "shell" (the standard UNIX command interpreter), and each message handling activity is a separate command. Each program is driven from and updates a private user environment which contains information permitting MH to be custom tailored. MH stores each message as a separate file and utilizes the tree-structured UNIX file system to organize groups of files into directories, or "folders." All UNIX facilities for dealing with files and directories are applicable to messages and folders, obviating the need for code that duplicates the

supporting-system facilities. This report will familiarize nonusers with the general features of message handling systems, and it provides a complete user's manual for system users. 41 pp. Ref.

R-2379-AF Overview of the Air-Ground Actions Two-Sided Engagement (AGATE) Simulation Model. J. R. Lind. April 1979.

An overview of AGATE, a simulation model that permits the user to examine alternative weapon systems and battle plans in a combined arms environment. The model is designed to measure the impact of weapon systems characteristics, organizational structure, doctrine and tactics, and terrain and environment on the outcome of battles. The tanks, armored personnel carriers, artillery, air, and counterair systems that make up the attack and defense combined arms teams are brought together with their respective battle plans to permit examination of the contribution of each to the outcome of battles and firefights. Programmed in FORTRAN IV, AGATE was developed as a tool for use by operational planners and military analysts in studying battle outcomes influenced by alternative mixes of weapon systems and plans. It is particularly applicable to the measurement of impact on air during the attacker advance, deployment, and engagement phases of a ground battle. 39 pp. Ref.

R-2391-AF Aircraft Turbine Engine Monitoring Experience: Implications for the F100 Engine Diagnostic System Program. J. L. Birkler, J. R. Nelson. April 1979.

A briefing report examining experience gained from six aircraft turbine engine monitoring system case studies and their implications for the F100 Engine Diagnostic System (EDS) under development for the F-15 and F-16 aircraft. Emphasis is on the substance of the EDS program, how it relates to previous engine monitoring experience, and some policy options. Two case studies are presented in detail: the U.S. T-38 Engine Health Monitoring System and the British Engine Usage Monitoring System. Conclusions are: (1) Experience does not warrant optimistic near-term cost reduction. (2) The flight-test plan, as currently designed (October 1978), is unlikely to yield conclusive evidence on the value of the EDS. (3) The present scope of the EDS omits valuable long-term design feedback and potential improvement to testing cycles. Recommendations are: (1) Develop a phased implementation schedule. (2) Provide a continuous recording option. (3) Revise the life-cycle analysis to reflect more completely the costs and benefits of the EDS relative to both aircraft and engine. 34 pp. Ref.

R-2401-AF Military Weather Calculations for the NATO Theater: Weather and Warplanes VIII. R. E. Huschke, R. R. Rapp, C. Schutz. April 1980.

Fourteen weather data analyses applied to military problems are presented. These are selected from past, hitherto unpublished, contributions to RAND research projects. Emphasis is divided between (1) statistical presentations of weather variables that affect aircraft operations—mainly ceiling and visibility, jointly and independently, and (2) model-generated statistics of atmospheric parameters that affect visual and infrared sensor systems—visible contrast

and infrared transmission, and target detection probabilities. Calculations are for the NATO theater with heavy emphasis on Germany. 129 pp. Ref.

R-2404-AF An Assessment of Recent Imaging Infrared Maverick Tests: A Briefing (U). D. E. Lewis, R. L. Blachly, T. T. Connors, N. W. Crawford, J. W. Ellis, Jr., J. R. Hiland, R. E. Huschke, F. Kozaczka, G. F. Mills, L. G. Mundie, E. H. Sharkey, H. W. Wessely, R. A. Wise. September 1979. Confidential.

(U) Presents the charts and text of a briefing summarizing an assessment of the imaging infrared (IIR) Maverick seeker/tracker in the context of air-to-ground combat in the European theater. The study relied primarily on data from recent Air Force tests, but it also made use of analyses in other areas, drawing on RAND's perception of the characteristics of the mid-1980s European battlefield. In addition, the study examined the impact of possible engineering changes being considered by the contractor. The Air Force European test results, plus proposed engineering changes, suggest that the production IIR Maverick seeker/tracker is likely to perform satisfactorily under typical European weather conditions. The degree to which this capability is realized depends on broader force employment issues, which were not within the scope of the European test, but are discussed in this report. 54 pp. Ref.

R-2408-AF Low Altitude Attack Against Armor: A Briefing (U). N. W. Crawford, R. L. Blachly, R. E. Huschke, W. H. Krase, F. A. Tatum, H. W. Wessely. March 1979. Confidential.

(U) The introduction of large numbers of mobile, radar, and electro-optically directed surface-to-air defenses in Central Europe by the Soviets has prompted consideration of very low altitude flight operations as one option for reducing attrition to friendly ground attack aircraft. This report examines the impact on aircraft survivability of a continuous low altitude attack tactic (200 ft or less) in a surface-to-air missile defended environment and the capability of the aircrew to locate and effectively attack worthwhile armored targets while flying at such low altitudes. A concept for an off-bore-sight dispenser munition which is compatible with low altitude flight is proposed as a possibility for obtaining high armor kill rates on a single pass while maintaining minimum exposure to the defenses. 25 pp.

R-2410-AF The Soviet and Cuban Intervention in Angola (U). S. T. Hosmer. December 1978. Secret NOFORN WNINTEL.

(U) A case study of the successful Soviet and Cuban intervention in Angola from late 1974 to early 1976. The report explores the motivations and apparent calculations of opportunity and risk that conditioned the intervention, examines the interactions between Soviet and Cuban moves and those of the United States and other interested parties, and evaluates external contributions to the outcome, including responsiveness to changing battlefield requirements. Unique attributes of the Angolan situation enabled the Soviets and Cubans to achieve victory at comparatively low military and political cost. In pursuing a policy that was strategically assertive but tactically cautious, the Soviets

probably saw little risk that their intervention would result in a direct military confrontation with the United States, an expectation shaped by their perception of the political constraints prevailing in the United States, by Washington's initial passive reaction to developments in Angola, and by the restrained behavior of the United States once it became involved. 68 pp.

R-2417-AF The Warsaw Pact Northern Tier (U). A. R. Johnson, R. W. Dean, A. R. Alexiev, J. F. Brown. November 1979. Secret NOFORN WNINTEL.

(U) Commonly accepted scenarios of Warsaw Pact warfare against NATO assume that over half of initial Pact offensive forces would consist of Czechoslovak, East German, and Polish units. These Northern Tier military institutions and their roles domestically and within the Warsaw Pact are examined in this study. The officer corps of all three military establishments are outwardly committed to a Soviet-defined "lightning war" strategy. This strategy may constitute the principal Soviet lever for ensuring Northern Tier participation in a Warsaw Pact offensive, but how reliably the conscript armies would in fact fulfill that intended role is another question. In any case, Pact preparations for "coalition warfare" imply weaknesses and vulnerabilities that deserve careful attention in light of the distinctive individual characteristics of the respective Northern Tier military establishments. 206 pp.

R-2417/1-AF/FF East European Military Establishments: The Warsaw Pact Northern Tier. A. R. Johnson, R. W. Dean, A. R. Alexiev. December 1980.

This is an unclassified version of R-2417. 205 pp.

R-2418-AF Transient Response of a Heterodyne Receiver: Implications for a Time-of-Arrival System. T. F. Burke. November 1979.

A directional antenna is a filter whose response varies with direction. A modulated signal transmitted from such an antenna produces different far-field waveforms in all directions (except for possible symmetry). The response of a receiver to the transmission will vary with position in the antenna pattern of the emitter. This effect is ordinarily negligible but it could limit the ultimate performance of any system that accepts off-axis signals and relies upon the details of waveform. In a leading-edge time-of-arrival (TOA) system used to determine the location of a pulsed emitter, the several receivers necessarily lie at different angular positions from the emitter. This analysis indicates that in a simple, idealized TOA system that would otherwise be entirely free from error, the waveform effect arising from a directional emitter can lead to errors of several dozen meters in the computed location. 213 pp.

R-2419-AF Surprise Attack: A Conceptual Approach to Assessing Soviet Potential Against NATO (U). M. G. Weiner. April 1979. Secret Intelligence Information NOFORN.

(U) Reviews four historical cases of surprise attack in terms of some common perceptions about surprise attack against NATO. Considers several dimensions of surprise, and the

explanations of surprise attack developed by Wohlstetter, Whaley, Handel, Ben-Zvi, and Elliott. Based on this, the author identifies the factors in surprise: availability of forces, intention to attack, planning for the attack, doctrine, and technological capabilities. The author then uses these factors as a conceptual framework for assessing Soviet/Warsaw Pact potential for surprise attack in Europe, under six attack options and concludes that as long as the Soviets can choose when, where, and how they attack, it is virtually impossible to prevent them from achieving some degree of surprise, ranging from very high to marginal among the six attack options. 98 pp. Ref.

R-2421-AF Military Airlift to Third Areas. U.S.-USSR Comparison and U.S. Options: A Briefing (U). P. M. Dadant. March 1979. Secret Intelligence Information NOFORN.

(U) Compares U.S.-Soviet airlift capabilities to four areas: the Eastern Mediterranean, the Persian Gulf, East Africa, and South-Central Africa. The report examines the effects for U.S. capabilities of having, versus not having, five options: overflying land that belongs to countries other than the United States or the destination country; using enroute bases not on U.S. soil; completing the C-141B "stretch" program; buying Advanced Tanker Cargo Aircraft; and adopting the Civil Reserve Air Fleet modification program. Because these options may still leave the United States with airlift delivery capabilities inferior to those of the Soviets in the mid-1980s—at least for destinations close to the USSR—the report suggests that options outside the scope of the study be explored, such as added outsize-carrying capability and selected prepositioning. 35 pp.

R-2429-AF Air Force Manpower, Personnel, and Training: Roles and Interactions. B. E. Armstrong, S. C. Moore. June 1980.

Provides the first consolidated summary of the Air Force's Manpower, Personnel, and Training (MPT) system; and describes the formal and informal functions of the system's three components. The components obviously interact: "Manpower" determines requirements for people and distributes budget-approved authorizations; "Personnel" determines management policies and tries to fill authorized positions with the right people; and "Training" recruits, classifies, and trains enlisted personnel. The report emphasizes links among the components and explains how the system relates to the Planning, Programming, and Budgeting System. The Air Force can therefore use the report to identify needed improvements and to introduce newcomers to the MPT system's structure and functions. 44 pp. Bibliog.

R-2432-AF FLIR-Aided Target Acquisition Using Localized Search. H. W. Wessely. November 1979.

Presents a theoretical calculation of the probability of acquiring a single vehicle-sized target on the ground by a FLIR-aided observer in a high-speed, low-altitude aircraft. The target's position is assumed to be approximately known and the aircraft is assumed to fly a straight-line, constant altitude course toward the predicted target position. The observer's task is to find the target in the clutter in the avail-

able search time. An exponential observer search law is assumed. There is a theoretically optimum search area for any given scenario. Sample calculations of the acquisition probability are made for a hypothetical FLIR sensor of fixed angular field of view and for a hypothetical sensor covering the optimum search area. The results for the optimum search area sensor are interpreted as an approximation to the performance achieved when a high-resolution, narrow field-of-view, sensor is panned in the vicinity of the predicted target position. 92 pp. Ref.

R-2435-AF An Introduction to the ISIS Interactive Information System. H. J. Shukiar, C. H. Bush, R. C. Gam-mill. April 1979.

Describes in a tutorial manner ISIS, an interactive database management system developed on the PDPII computer under the UNIX timesharing system. ISIS, designed for computer-naïve users, uses an English-like command language to give the user the ability to view, modify, and otherwise reorganize his database. ISIS operates on databases of modest size, exploiting the unique characteristics associated with such databases. The tutorial focus is tactical command and control, but ISIS is more generally applicable. The report introduces the ISIS command language in stages, and the user with access to RAND's PDPII/70 can try ISIS out on the command and control database utilized in the report. The report also discusses the system development philosophy adopted during ISIS implementation. 93 pp.

R-2436-AF Quality of Care Provided by Physician's Extenders in Air Force Primary Medicine Clinics. G. A. Goldberg, D. G. Jolly. January 1980.

Evaluates the quality of care of physician extenders (PEs) (23 physician assistants and seven primary care nurse practitioners) in Air Force primary medicine clinics, as part of an evaluation of PEs assuming care formerly provided by physicians. PEs performed at least as well as M.D.s on 25 out of 28 nonredundant process-of-care criteria. Nurse practitioners met the M.D. standard on 14 of 19 criteria. No major differences were found in PEs' use of ancillary services (laboratory and X-ray) or orders for further care when controlling for case-mix. As expected, PEs consulted M.D.s infrequently, but more often for serious complaints and at rates similar to those found in other PE studies. The study concludes that the Air Force can deliver the same quality of care when PEs treat a sizable proportion of patients formerly treated by M.D.s. 78 pp. Bibliog.

R-2440-AF Aircraft Turbine Engine Monitoring Experience: An Overview and Lessons Learned from Selected Case Studies. J. L. Birkler, J. R. Nelson. August 1980.

Two approaches have evolved in attempts to improve engine operations, maintenance, and management while reducing support costs. The first concentrates on short-term practices (inflight data are recorded in a snapshot mode). The second approach focuses on long-term benefits through improved knowledge of the operating environment (data must be recorded continuously on at least a few aircraft). Engine duty-cycle research by the military services has demonstrated that neither the services nor the manufactur-

ers have a clear idea of power requirements and frequent throttle movements during operational sorties in fighter aircraft and have generally overestimated engine parts life and underestimated expected life-cycle costs. The narrow concept of cost savings over the short term should not be the sole criterion on which monitoring systems are judged. Monitoring systems for recent and future engines should include continuously recorded data now that reliability, durability, and cost issues are almost on an equal footing with performance. 97 pp. Bibliog.

R-2469-1-AF Battle Management for the Strategic Bomber Force: The Need and the Feasibility (U). E. C. Taylor, W. W. Matyskiela. March 1980. Secret.

(U) A general concept of battle management from an analysis of strategic air battles. The authors conclude that the bomber force may need real-time management if it is to penetrate the Soviet air defense in the 1990s; the technology needed for a battle management system is available; and a laboratory should be developed and operated over the next five years to define a design for the data processing at the man-machine interface. The authors define a command-and-control system to provide the battle manager with real-time information about problems and opportunities and to help in real-time replanning. The required hardware—communications systems, surveillance systems, navigation systems, and high-capacity airborne computers—is assumed to evolve from existing technologies. Promising results from laboratory research projects that pertain to defining the man-machine interface in a decision-support system include demonstrations that expert knowledge can be transferred to computers and that the computers can then interact with decisionmakers to help with real-time situation assessment and planning. 36 pp. Ref.

R-2473-AF Writer-to-Reader Delays in Military Communications Systems. N. E. Feldman, W. Sollfrey, S. Katz, S. J. Dudzinsky, Jr. October 1979.

Background material to place in proper context the effect of the use of millimeter-wave earth-to-satellite links on military communications. The complete writer-to-reader message path is described, including administrative delays (approval, awaiting pick-up, local mail delivery), communications processing, and transmission time. Analysis of statistics on speed of service for AUTODIN, the principal military communications network at present, shows that the smallest contributions to the total message delay come from communications transit time, the only system delay that would be affected by rain outages in millimeter wave links. Over 25 percent of high-precedence traffic is delayed by several hours in administrative handling. The delay distribution is severely skewed toward larger delays, and the AUTODIN network serves the majority of users much better than is indicated by the mean delay. The report is a basic building block to place rain outages on EHF links in a realistic perspective. 61 pp. Ref.

R-2476-AF Alternatives for Mobilizing Soviet Central Asian Labor: Outmigration and Regional Development. S. E. Wimbush, D. F. Ponomareff. November 1979.

The Soviet leadership is facing increasingly difficult demographic problems, one of which is a sharp imbalance between labor deficits in the European regions and labor surpluses in Central Asia and the Caucasus. This disparity could affect several Soviet policy areas, including growth strategy, leadership perception of resource allocation compromises, and military manpower decisions. Two policy options are discussed in this report—outmigration and regional development. These are available to the Soviet leadership to make better use of Central Asian labor resources, as well as several mobilization strategies that the regime currently uses to this end. The demographic, economic, and political variables underlying the regime's choice of policy alternatives in Soviet Central Asia are examined. It is concluded that outmigration and regional development by themselves or even taken together cannot solve the Soviet labor problem. They should be seen as parts of a larger campaign that must include substantial economic reform. 38 pp. Bibliog.

R-2491-AF Capabilities for Military Airlift to Third Areas: U.S. Airlift Fleet Improvements and U.S.-USSR Comparisons for 1978 and the Mid-1980s (U). P. M. Dandant, A. A. Barbour, J. W. Higgins. December 1979. Secret NOFORN WNINTEL.

(U) Compares 1978 and mid-1980s U.S. and Soviet airlift capabilities to the Eastern Mediterranean, the Persian Gulf, East Africa, and South-Central Africa. The results show the dependence of the capabilities, and therefore of the comparison, on the specific destination, the routes available to each side, whether usable foreign bases are available, whether the Soviets acquire additional outsize-capable aircraft, and the relative fleet utilization rates (average flying hours per aircraft per day) achieved by the two sides. The report also examines some U.S. options for improving U.S. capabilities and suggests relative priorities among these options. Because these may still leave the United States with mid-1980s airlift delivery capabilities inferior to those of the Soviets, it suggests other options that appear worthy of analysis, such as buying additional outsize-capable aircraft and prepositioning army equipment. 232 pp. Ref.

R-2522-AF The Relative Efficiency of Military Research and Development in the Soviet Union: A Systems Approach. G. Ofer. November 1980.

The Soviet military R&D sector benefits from a wide range of material, administrative, and other priorities, which impose heavy opportunity costs, especially on civilian R&D. R&D is relatively more expensive in a command economy, so less of it should be used than in a market system. The Soviet use of much less R&D in its military sector is as rational as the American use of much more R&D where R&D is relatively less expensive. If less military R&D is used in the USSR, a measure of its efficiency derived as a ratio of military output to military R&D is biased upward. The relative efficiency of Soviet military R&D is probably much lower than otherwise assumed because input costs are higher and output lower than usually estimated. The arms race is costlier to the Soviet Union than otherwise believed, both absolutely and as an alternative to economic development. 47 pp. Ref.

R-2528-AF Outlasting SALT II and Preparing for SALT III. W. E. Hoehn, Jr. November 1979.

Attempts to answer three questions regarding the strategic arms limitation talks (SALT): (1) Given that SALT II in and of itself does not resolve our major strategic problems, does it provide a framework within which planned U.S. unilateral actions would resolve those problems? (2) If not, what kinds of additional limitations should the next round of negotiations—SALT III—aim for? (3) What set of plans and what strategy offer some promise of leading to an effective SALT III outcome? Some prospect is offered in at least one construct of SALT III, through lower ceilings and more explicit limitations on missiles, of permitting U.S. unilateral actions to redress the strategic balance. The suggested approach is to pursue an option-generating R&D strategy consistent with the provisions of SALT II. The issue is whether the U.S. political system can do a better job of competing while cooperating with the Soviet Union, rather than merely switching intermittently from one course to the other. 50 pp.

R-2529-AF Organizational Analysis of Soviet Military Procurement (U). A. J. Alexander. June 1981. Secret NOFORN WNINTEL.

(U) Assessment of the influence of Soviet decisionmaking practices on weapons procurement. The effects are examined of organizational structure, routines, culture, doctrine, and politics. Both "conventional" and "new-in-principle" weapons are traced through the decision process. The report concludes that although political choices have established the main policy lines, both the choices and their implementation are strongly conditioned by decisionmaking procedures and organizational relationships. The military maintains a near-monopoly of information and expertise on military affairs. Strong forces encourage new alternatives that differ little from the old. Major change therefore requires political intervention in decisionmaking. But the leadership of the past 15 years is also incrementalist, partly because of its collective character. We can therefore expect continuity until new policies are broadly supported—most probably by a new leadership facing serious crisis. 94 pp.

R-2541-AF Estimating Military Personnel Retention Rates: Theory and Statistical Method. G. Gotz, J. J. McCall. June 1980.

A Dynamic Econometric Retention Model (DERM) is designed for studying the effects of alternative compensation policies on the retention behavior of Air Force officers, including the Uniformed Services Retirement Modernization Act, the President's Commission on Military Compensation, and the Uniformed Services Retirement Benefits Act. DERM is a model of sequential behavior containing the appropriate econometric method for estimating retention rate. The econometric method is a maximum likelihood procedure endogenously determined by the specification of the behavioral model. It differs from earlier approaches in that it explicitly considers behavioral effects flowing from decomposing the disturbance term into permanent and transitory components. An implication of DERM is that retention rates depend both on prospective future returns to remaining in the military and on past occurrences. If this is

correct, then simple regression models should overpredict the retention gains of proposed compensation policies, exactly what happens in two recent reenlistment studies using regression analysis. 38 pp. Ref.

R-2563-AF Estimates of U.S. and Soviet Strategic Naval Defensive Capabilities (U). A. F. Wolf. May 1980. Secret NOFORN WNINTEL.

(U) Considers three questions of importance in the strategic naval arena. The first is the rate at which U.S. SSBNs on patrol might be detected and sunk by Soviet SSBNs conducting open-ocean search. The second is the rate at which Soviet SSBNs in protected sanctuaries might be sunk by intruding U.S. SSBNs. The third is the survivability of Soviet SSBNs deployed off the continental United States when U.S. strategic surveillance and air ASW assets are devoted against them at the onset of hostilities. The force employment and weapons effectiveness assumptions have been made from the perspective of a Soviet planner. Numerical values, however, were obtained from recent Naval studies of undersea warfare. Various tactical and operational assumptions and limitations are specifically stated as caveats in the text. Results derived are tentative and have yet to be validated against other campaign analyses. 67 pp. Ref.

R-2565-AF A Method for Estimating the Cost of Aircraft Structural Modification. J. L. Birkler, J. P. Large. March 1981.

Describes research into the cost of aircraft structural modifications. Detailed cost and man-hour data supplied by the airframe industry permitted derivation of estimating tools for major aircraft components. Separate equations were derived for engineering, tooling, manufacturing, and material cost. The major explanatory variable was always weight. It was hypothesized that structural modification cost could be estimated on the basis of the weight of material added. Estimates of the cost of modification for the B-52, C-141, C-5, and EF-111 were compared with cost data from industry. Considerable informed judgment is required as is a knowledge of such program-specific facts as whether the original production tooling still exists. Rather than a mathematical model, the study describes the kinds of information needed, suggests guidelines, and presents estimating equations for airframe systems and subassemblies. These contribute to an understanding of the estimating problem but do not constitute a general solution. 146 pp.

R-2566-AF The Dynamics of Factions and Consensus in Chinese Politics: A Model and Some Propositions. L. W. Pye. July 1980.

A study of the dynamics of factionalism in Chinese politics: the tension between the imperative of upholding consensus, and the need of officials to seek the security of networks of personal relationships that create counterconsensus factions. These networks are more sensitive to career and power considerations than to ideology, geography, or policy issues. The psychological and cultural roots of factional behavior affect styles of decisionmaking and implementation (causing exaggerated cycles of bureaucratic paralysis, compulsive activity, and again paralysis), modes of political communication (the powerful must use code words, while the

weak can be explicit), and a widespread, self-fulfilling belief that any form of intra-elite disagreement will endanger the stability of the political system. 250 pp.

R-2567-AF Software Requirements for Embedded Computers: A Preliminary Report. S. Glaseman, M. Davis. March 1980.

Results of a study of Air Force procedures for formulating and communicating software requirements and their effects on software acquisition for embedded computers. Conceptual models are used to describe software acquisition management activities of the Air Force and software development activities of prime contractors. Compared to contractors, the Air Force gives relatively little attention to software during preprogram decisionmaking. Moreover, the nature of software acquisition management problems is changing, and management techniques are applied to embedded software with little regard for comparative maturity of different application areas. At a more detailed level, the type of software expertise required has become at least as important as the numbers of specialists; documentation produced in response to current military standards is of questionable utility to any audience; the review structure is becoming increasingly inadequate; and separate system definition contracts appear desirable whatever the type of system being considered. Promising areas for further research are identified. 34 pp. Ref.

R-2572-1-AF Analysis of Subjective Judgment Matrices. G. B. Crawford, C. Williams. May 1985.

A popular method for quantifying subjective judgment utilizes the dominant eigenvector of a matrix of paired comparisons. The eigenvector yields a scale of the importance of each element of a collection relative to the others. The scale is based on a matrix of subjective paired comparisons. Thomas Saaty has shown this to be a useful tool for analyzing hierarchical structures in many military and industrial applications: by estimating the scale at each level of a structured problem, this procedure yields the relative importance of the elements at the bottom level of the hierarchy to the goals or output at the top level. The geometric mean vector is computationally easier than and statistically preferable to the eigenvector. Further, the geometric mean vector is applicable to a wider class of problems and has the advantage of arising from common statistical and mathematical models. The statistical advantages are theoretically and empirically demonstrated. 34 pp. Bibliog.

R-2579-AF Soviet Strategic Conduct and the Prospects for Stability. B. S. Lambeth. December 1980.

Throughout the past decade, the Soviets have refused to entertain SALT proposals that would require the Soviet Union to become an active partner in increasing its own vulnerabilities. They have also revealed a penchant for immoderate levels of arms acquisition, which raises disturbing questions about their willingness to settle for a strategic posture "essentially equivalent" to that of the United States. These features of Soviet strategic style constitute major obstacles in the path of achieving a cooperative solution to the security dilemma traditionally espoused by Western theories of mutual assured destruction. If the United States

is to endure as a respectable player in the strategic arms competition, it will have to begin imposing measures conducive to stability through a strategy that appeals primarily to Soviet sensitivities, rather than to the doubtful prospect of eventual Soviet convergence with the preferred concepts of the West. 15 pp.

R-2580-AF An Overview of the Soviet Threat. F. M. Sallagar. February 1980.

Current U.S. strategic planning rests on an assumption that the most likely cause of a major war with the Soviet Union would be a Soviet military attack on the United States or its European allies. This Project AIR FORCE report questions the validity of that assumption. The author examines the Soviet policy of "peaceful coexistence" against the backdrop of the Soviet military buildup over the past 15 years, and offers an alternative hypothesis for the source of war. He argues that the changing military balance has allowed the Soviet Union to adopt a policy designed to undermine the strategic position of the United States by means short of a direct attack. Effects of this policy are to disrupt global stability and encourage situations in critical areas that might bring about American intervention. This could precipitate a military confrontation with the Soviet or Soviet-supported forces, and become a more likely source of war between the two superpowers than a direct Soviet attack on the United States or its allies. U.S. defense policy has not made adequate allowance for this contingency. 32 pp.

R-2584-AF An Introduction to the TSAR Simulation Program: Model Features and Logic. D. E. Emerson. February 1982.

TSAR is a complex Monte Carlo simulation of a system of interdependent theater airbases that has been designed for analyzing the interrelations among on-base resources and the capability of the airbases to generate aircraft sorties in a dynamic, rapidly evolving wartime environment. On-equipment maintenance tasks, parts and equipment repair jobs, munitions assembly, and facility repair tasks are simulated for each of several airbases. Asset accounting for each of 11 classes of resources, and for each type within each class, permits assessment of a broad range of policy options that could improve the efficiency of resource utilization on a theaterwide basis. This report first introduces the reader to the scope of the TSAR simulation and to each of the activities that are represented in the simulation. The remainder of the report presents a series of comprehensive discussions of TSAR's logic for each of the types of events simulated. 57 pp. Ref.

R-2591/1-1-AF Support Improvements for F-15 Avionics: Vol. 1, Executive Summary (U). J. R. Gebman, N. Y. Moore, H. L. Shulman, C. L. Batten. March 1983. Secret.

This is an executive summary of R-2591/2-1. 23 pp.

R-2591/2-1-AF Support Improvements for F-15 Avionics: Vol. 2, Analysis (U). J. R. Gebman, N. Y. Moore, H. L. Shulman, C. L. Batten. March 1983. Secret.

(U) This study quantifies the amount of additional resources that the Air Force needed as of late 1979 to support the F-15's avionics equipment during a major war. To explore ways of improving support for the F-15's avionics, RAND joined three basing options with two investment options to form six distinct strategies for improvement. This report documents the findings of this research. Section II identifies the dominant constraints on support capability, and Sec. III describes various options for dealing with those constraints. Combining these options into alternative strategies, Sec. IV provides a quantitative analysis and Sec. V a qualitative analysis of each strategy. Section VI presents conclusions drawn from this research. Appendixes provide specific details to support the quantitative analysis found in Sec. IV. 91 pp.

R-2592-AF Analysis of the Warsaw Pact Tactical Rear: Summary Report (U). D.E. Lewis, R.L. Blachly, T.T. Connors, C.B. East, J.R. Hiland, G.F. Mills, R.A. Wise. January 1981. Secret.

(U) Summarizes an analysis of the vulnerability and exploitability of the Warsaw Pact tactical rear. Postulates a conventional attack by the Warsaw Pact against NATO, identifies those targets in the Pact tactical rear that are most critical, shows the impact on the Pact if they were effectively attacked, and evaluates NATO's effectiveness against them. Briefly describes the one-sided map exercise and two-sided computer model used in the study. Concludes that, under certain conditions, effective (selective, sufficient, and timely) attacks on the Pact tactical rear could slow and even stop FEBA movement. Both mobile and fixed "high-value" targets exist in the Pact tactical rear. The best way to use current (1980) forces is a combined indirect/direct attack tactic. Current efforts to develop an effective direct attack capability in night/adverse weather could have high payoff, but indirect attack should be given higher development priority than it presently has. 40 pp. Ref.

R-2592/1-AF Analysis of the Warsaw Pact Tactical Rear: Summary Report (U). D.E. Lewis, R.L. Blachly, T.T. Connors, C.B. East, J.R. Hiland, G.F. Mills, R.A. Wise. April 1981. Secret NATO Releasable.

This is a NATO-releasable version of R-2592. 36 pp.

R-2598-AF A Conceptual Framework for a National Strategy on Nuclear Arms. C.H. Builder. September 1980.

This essay proposes a national strategy for nuclear arms. It argues for new ways of thinking about why we possess nuclear arms and how we should plan for their control and use. The arguments are developed within a conceptual framework composed of three national security dimensions: (1) the goals supported by the possession or use of nuclear weapons, (2) the immediate objectives of our postures, and (3) the perceived proximity of conflicts. The formulation of logical strategy domains within this framework reveals some opportunities that have been historically neglected in U.S. nuclear arms policies. In particular, the essay suggests that our arms control efforts should be reoriented toward limiting theater forces and encouraging strategic defenses. 26 pp.

R-2599-AF Economic Constraints on China's Military Modernization (U). K.C. Yeh. December 1980. Secret Intelligence Information.

(U) Analyzes the effect of those constraints on China's strategic objectives and discusses the consequent significance for U.S. policies. To realize its goal of military parity with the superpowers, China has a two-phase plan: (1) using a minimum deterrence capability and people's war strategy to deter Soviet attack, thereby freeing resources to build an economic and technological base; and (2) beginning large-scale military modernization on this base. This program faces three major economic constraints: rate of economic growth and share of GNP that can be allocated to defense; shortage of foreign exchange to purchase vital technology; and shortage of technological personnel to absorb imported technologies. Consequently, U.S. policies on trade, financial aid, technology transfer, and arms sales can influence the pace and direction of China's military development. Any change in U.S.-China economic or military ties will probably affect China's resource allocation, economic growth, external security, and, thus, its political stability. 61 pp. Bibliog.

R-2601-AF A New Approach to Modeling the Cost of Ownership for Aircraft Systems. K.E. Marks, H.G. Massey, B.D. Bradley, J.Y. Lu. August 1981.

Illustrates estimation of support investment costs and recurring operations and support costs through a Model for estimating Aircraft Cost of Ownership (MACO), which also provides a framework for future research. MACO is an outgrowth of an earlier evaluation of the strengths and weaknesses of the most widely used aircraft life cycle cost models. It combines new algorithms for major, maintenance-related costs with formulas drawn from existing models for other cost elements. MACO relates a full set of ownership cost elements to component level reliability and maintainability characteristics and to aircraft design, operations, logistics, and deployment parameters, although the MACO equations would have to be reorganized before they could be used to estimate costs according to the cost structure of the latest Cost Analysis Improvement Group guide. MACO computes resource quantities in units that can be related directly to Air Force programming categories, including base maintenance manning (by work center), depot manning, and recoverable spares inventory levels. Output and input parameters accommodate annual changes in system parameters and operating conditions such as component reliability and aircraft inventory size and activity rates. 139 pp. Ref.

R-2605-DRE/AF An Analysis of Weapon System Acquisition Intervals, Past and Present. G.K. Smith, E.T. Friedmann. November 1980.

Critics of weapon system acquisition frequently claim that management process changes during the 1960s and 1970s caused the acquisition cycle to lengthen. A review of three classes of aerospace systems—aircraft, missiles, and helicopters—shows that over the past 30 years the time from the beginning of full scale development to delivery of the first operational item has changed only slightly, but average production rates have fallen by half. The planning

phase corresponding to today's Phase I (from Milestone I to Milestone II) has nearly doubled, and the introduction of Phase Zero may have added still more time, but evidence on Phase Zero effects is still tenuous. Opportunities for shortening the acquisition cycle time appear to lie mainly in flexible application of the regulations governing approval of the Mission Element Need Statement (MENS), and in some cases the Services should be allowed to proceed simultaneously with Phase Zero, and even Phase I, studies while the MENS is being reviewed. 142 pp.

R-2610-AF Target Damage and Civilian Casualty Interrelationships for a Soviet Surprise Attack on NATO Military Installations (U). J. W. Ellis, Jr., F. Kozaczka, R. H. Frick, J. A. Wilson. June 1981. Secret Formerly Restricted Data NOFORN WNINTEL.

(U) Examines the relationship between target damage and collateral civilian casualties resulting from a Soviet preemptive nuclear attack on selected NATO fixed targets in an unalerted, peacetime state. The analysis considers the implications of several feasible Soviet attack options of varying weapon yield and accuracy, with air or surface bursts, and for differing numbers and types of targets attacked. Use of the SNAPPER damage assessment technique provides Monte Carlo estimates of both the level and the variance of target damage and civilian casualties. Sensitivity investigations provide an appreciation of the effect on the results of uncertainties in many of the technological and operational parameters. The analysis indicates that, using medium-range missiles now entering service, the Soviets could control civilian casualties by choosing moderate-yield air bursts and by prudent target selection. Consequently, NATO planners should consider that the Soviets might believe the military advantages of a preemptive nuclear attack could outweigh the risks. 186 pp. Ref.

R-2611-1-AF Support Resources for F-15 Avionics: Data Collection and Analysis Procedures (U). J. R. Gebman, N. Y. Moore, H. L. Shulman, G. M. Burkholz, L. J. Batchelder, P. A. Ebener, G. Halverson, P. Kanoske-Dey, S. M. Polich. March 1983. Secret.

(U) This report describes the basis for results in R-2591/1-1 and R-2591/2-1, and it draws on RAND's experience with the Air Force to lay out a baseline set of data products and collection procedures that the Air Force could use to improve its ability to tackle the following objectives: estimate the expected capability of the avionics shops to support wartime flights, provide management visibility and tracking for test equipment use and capability, and identify specific problem areas for engineering investigation of airborne and shop equipment. The report describes a limited set of data products because it proceeds from the premise that data collection activities have value only to the extent that they generate a unique product that an organization must have to achieve an important objective. The report defines the data elements required to generate the proposed data products; it also describes the data collection and analysis procedures required to generate the data elements. 147 pp.

R-2620-AF Patients' Acceptance of Physician's Assistants in Air Force Primary Medicine Clinics. D. G. Jolly. September 1980.

Analyzes the reaction of patient populations to the reorganization of primary medicine clinics at four Air Force hospitals. Called the "panel system," the reorganization relied on large numbers of physician extenders (PEs)—physician's assistants (PAs) and primary care nurse practitioners—practicing in teams consisting of two or three PEs and a supervising physician. Each team was assigned a panel of patient families. All visits were to be by appointment. PEs received favorable ratings from a majority of patients, although from 10 to 20 percent were unfavorable. Even in this group, many felt that PAs could handle some simple medical problems. Most saw the panel system as an improvement and preferred it to an all-physician alternative. The new system improved satisfaction with access to care. The results strongly support continued reliance on PEs to provide Air Force primary medical care. 87 pp. Ref.

R-2624-AF Military Expenditure, Force Potential, and Relative Military Power. G. G. Hildebrandt. August 1980.

Military expenditure summarizes the flow of resources in the defense sector during some period of time; military force potential is a measure of the military output that can be produced with all the assets of the defense establishment, many of which are acquired over an extended period of time. The analysis presents a measure of military output called force potential which adjusts military expenditure to compensate for the durable character of many military assets. Soviet military expenditure information and a hypothetical military capital stock series for the Soviet Union are used to compute the growth of military force potential for 1967-1972. Also proposed is an indicator of the relative military power position of the United States in the long-term competition with the Soviet Union. 32 pp.

R-2633-AF Effects of the Use of Millimeter Waves on the Statistics of Writer-to-Reader Delays in Military Communications Systems. W. Sollfrey. December 1980.

The distributions of the several time intervals which form the total message delay in the AUTODIN I military communications system are found from measured data. The handling delays at the destination station provide the greatest contribution to the total delay, and the interstation transit time provides the least. The rain rates required to produce an outage on certain millimeter-wave satellite links are found, and the distribution of the duration of such rates is also determined. These duration distributions are combined with the AUTODIN data, and show that during rain periods there are significant increases in Flash transit time delays, but slight to negligible effects on Flash total delay and on the transit or total delay for all messages. All effects are negligible on an annual average basis. Thus, delays are not a reason to forgo the several advantages of millimeter waves. (See also R-1936, R-2473.) 87 pp. Ref.

R-2636-AF Comparative Adequacy of Steady-State Versus Dynamic Models for Calculating Stockage Requirements. J. A. Muckstadt. November 1980.

Presents a two-echelon inventory model for Air Force recoverable items in periods of dynamic change in the demand process, such as during initial provisioning or war-time. Affirms that steady-state models should be used only or mostly when flying activity is relatively stable. The report also investigates the validity of a longstanding assumption in the mathematics of inventory systems: that depot delay in the resupply of serviceable parts to a base is independent of the number of units in base resupply. Comparing the outputs of two dynamic models, one embodying the assumption and the other entailing meticulous computations, the author concludes that the assumption, although untrue, has a negligible effect on performance measurement and stockage requirements, and that logisticians therefore may freely embody it in their models because of its mathematical convenience. 47 pp. Ref.

R-2639-AF Acquisition Options for Fighter Aircraft: The ACEVAL Test. C. T. Kelley, Jr., H. G. Hoover, M. D. Miller. November 1980. Not Reviewed for Public Release.

Documentation of the results of the first task of a new Project AIR FORCE study entitled Acquisition Options for Fighter Aircraft. The objective of the task was to determine the implications of the results of the 1977 joint Air Force-Navy ACEVAL (Air Combat EVALuation) air combat test for future air-to-air combat and for Air Force acquisition policy for fighter aircraft. ACEVAL's principal goal was to determine the effect of varying the numbers of fighter aircraft on the outcome of aerial combat. The authors' analysis of ACEVAL results suggests a possible "high-low" strategy for fighter aircraft acquisition which would be a mix of aircraft: the "high," sophisticated component would be equipped to detect, sort, identify, and attack enemy aircraft at long range. The "low" component would be smaller and less costly aircraft (and thus more numerous) equipped with all-aspect missiles. Advantages and disadvantages of this strategy are discussed as well as implications for the F-15 and F-16 modernization programs and where the F-5 might fit into the USAF force structure. 34 pp.

R-2662-AF A Comparison of the Polish and Soviet Armaments Decisionmaking Systems. M. Checinski. January 1981.

The accessible Polish literature, the author's experiences in Poland, and interviews with former key Polish personnel open a "window" on the Soviet military-industrial complex. Discussion of Polish and Soviet systems identifies and describes links from the highest decisionmaking body (the Polish Committee for National Defense, the Soviet Defense Council) through intermediate military-bureaucratic bodies (Military Industrial Commission, General Staff components, the military group of each Central Planning Commission, the military departments of the industrial ministries) to the military "buyers" (voenpredy) in the factories, institutes, and other enterprises. The Soviet Defense Council military doctrine and strategy influence all economic planning and development in the USSR. The military elite and the military-oriented Party leaders tend to push for rapid modernization, while the military industrialists are reluctant to change. The direction of Soviet defense policy and the size of Soviet military forces are decided solely by

the Party First Secretary and the Politbureau together with the Defense Council. 87 pp.

R-2665-AF The Economics of Military Capital. G. G. Hildebrandt. August 1980.

Military capital is an aggregate measure of all durable assets of the defense establishment. The report investigates two related measures of military capital: the instantaneous productive capacity of military capital, which equals the total monetary value of the benefits provided by the assets at some point in time; and the long-run productive capacity of military capital, which equals the monetary value of the benefits provided by the assets over the remainder of their service lives. These two measures can be determined by utilizing information that is likely to be available to the analyst. Both deterioration and changes in asset quality are properly accounted for in the determination. 29 pp. Ref.

R-2687-AF Risk and Uncertainty in Soviet Deliberations about War. B. S. Lambeth. October 1981.

Surveys the elements of risk, uncertainty, and unpredictability that might moderate Soviet behavior and undermine the confidence with which Soviet decisionmakers would consider entering into a major military engagement with the United States. Although the report does not question the substantial threat implications of Soviet force improvements that have been under way in recent years, it does describe certain realities of Soviet style and leadership concern about possible Soviet military inadequacies that make the more ominous features of Soviet doctrine and force development appear somewhat less alarming. The analysis is based on a combination of evidence suggested by past Soviet crisis behavior, information offered in Soviet literature concerning troop management and training, and inferences from known or suspected Soviet political practices, organizational characteristics, and operational concerns. 28 pp.

R-2688-AF Soviet Policy and Practice Toward Third World Conflicts (U). S. T. Hosmer, T. W. Wolfe. August 1981. Secret WNINTEL NOFORN.

(U) Examines past Soviet involvements in Third World conflicts, political-military conditions encouraging such intervention, and the possible thrust of future Soviet behavior. The Soviet invasion of Afghanistan in 1979, following closely the Soviet-Cuban interventions in Angola and Ethiopia, and increases in Soviet power-projection capabilities underline the importance of Third World contingencies for U.S. defense planners. Part One traces the evolution of post-World War II Soviet policy and practice toward the Third World. Part Two analyzes the principal attributes and patterns of Soviet Third-World conflict behavior, including how the USSR has managed the risks of Third World involvements. Future Soviet behavior in the Third World will depend on the extent to which Moscow perceives the United States as resolved to commit and capable of committing its power to check further Soviet expansion. The United States must define and articulate its interest in potential intervention situations early; reinforce Soviet fears of the danger of escalation in direct U.S.-USSR confrontation; and pursue a policy of anticipatory involvement. 301 pp. Bibliog.

R-2688/1-AF Soviet Policy and Practice Toward Third World Conflicts: Executive Summary (U). S. T. Hosmer, T. W. Wolfe. August 1981. Secret WNINTEL NOFORN.

This is an executive summary of R-2688. 29 pp.

R-2719-AF Subjective Transfer Function Approach to Complex System Analysis. C. T. Veit, M. Callero. March 1981.

The subjective transfer function (STF) approach, a new procedure for analyzing complex systems that involve numerous cause and effect relationships among the system components, is described. A tactical air command and control and force employment system is used to illustrate measurement problems found with other procedures commonly used in complex system analyses and their resolutions in the STF approach. In the STF approach, system "experts" are involved in defining the complex system components and constructing their network of cause and effect relationships. Each hypothesized relationship is transformed into an STF that specifies how described components affect judged outcomes. The STFs are tested by using proper experimental designs in generating questionnaires that are given to "experts." Decisions are then made about the appropriateness of the initially hypothesized system components and the form of the STF. Appropriate STFs are used to assess how changes in the system affect system outcomes. 38 pp. Ref.

R-2727-AF The Effectiveness of Air Force Alcohol Education Seminars. M. B. Carpenter-Huffman, B. R. Orvis, D. J. Armor, G. M. Burkholz. September 1981.

An evaluation of the Air Force Social Actions Seminar Program for educating personnel about drug and alcohol abuse. The authors analyze the objectives, cost, implementation, and effects of the program, and recommend policy changes to improve the effectiveness and efficiency of prevention efforts. Conclusions are that although the seminars have some immediate effects on several attitudinal and informational measures, they are not large and diminish with time. Recommendations are that prevention objectives for the total Air Force population be limited to information transmission and that attempts to change attitudes and behaviors be reserved for special groups, such as at-risk individuals or persons responsible for identifying personnel with alcohol problems. These measures would entail (1) strengthening substance abuse education in Basic Military Training, programs for incoming officers, and base-level orientation programs; (2) increasing the responsibility of supervisors responsible for identifying persons with alcohol problems; and (3) expanding the Alcohol Awareness Seminar for persons with less serious or incipient alcohol problems. 116 pp. Ref.

R-2736-AF Silent SAM: A Cooperative Air Defense System (CADS) Concept (U). R. E. Horvath, W. P. Hutzler, R. Y. Pei, B. F. Powers. May 1981. Secret.

(U) Silent SAM is a cooperative air defense system concept designed to enhance the survivability and effectiveness of surface-to-air missiles by means of electromagnetic emission control. This report examines quantitatively the effec-

tiveness of such a concept and presents the results of an analysis using an aggregate model designed to capture the major elements of the operation. 79 pp. Ref.

R-2741-AF Defense Space Issues: Crews in Space, Future Payloads, and Future Launch Systems (U). D. Leinweber, B. W. Augenstein, M. L. LaCasse, L. N. Rowell, R. M. Salter, Jr. November 1982. Secret.

(U) This report considers the effects on planned Department of Defense space projects of space shuttle program contingencies resulting in capacity reduction or periods of unavailability. It also considers constraints placed on space development by shuttle utilization plans. Examination of a large set of proposed defense space missions and of the demands their development and deployment will place on the shuttle or other U.S. space launch systems clearly indicates that the shuttle alone cannot provide for many desirable future space missions. The conclusions are (1) the current space test program does not adequately address the issues raised regarding the employment of defense crews in space; (2) the possibility of shuttle program shortfalls provides a motivation for removing as many nonessential missions as possible from the shuttle schedule to allow for using the unique capabilities of the shuttle to resolve questions about the role of crews in space; (3) many proposed payloads cannot be accommodated with current space transportation system facilities and schedules; and (4) launch systems supplementing the shuttle will be needed indefinitely. 187 pp. Ref.

R-2752-AF The Burden of Soviet Defense: A Political-Economic Essay. A. S. Becker. October 1981.

Poses two questions: How can we explain the monotonic growth of the Soviet military budget over two decades when overall economic growth was slowing down? Can changes in this pattern be expected? Section II defines and analyzes the concept of the Soviet defense burden, then surveys empirical measures of the burden. Section III is skeptical about the extent to which the Soviet buildup is a response to external threats to security. The persistent buildup is seen instead to reflect the leadership's perception of national priorities and to be supported by a decisionmaking apparatus that maintains them. In the near future, external challenges (particularly the U.S. buildup) and opportunities will create pressures to maintain the pace of military spending, but worsening economic prospects will make it increasingly burdensome. Neither Brezhnev nor his successors is likely to have new options for dealing with this dilemma, and considerations that have induced the Politburo to try to "muddle through" will probably continue to dominate. U.S. policy has a significant capacity to influence Soviet policy in this direction. 86 pp. Ref.

R-2757-AF Flying by FLIR: Promise and Problems (U). H. W. Wessely. October 1981. Confidential.

(U) Addresses the question of the feasibility of flying night/adverse weather tactical air missions with a FLIR sensor used as the primary piloting aid. The bulk of the report consists of theoretical estimates of what size objects can be detected at what distances for 95 percentile Central European weather conditions. The analysis establishes that obsta-

cles of 10 meters minimum dimension can be reliably detected at ranges of at least 3 km. The results of the relatively few experimental attempts to fly by FLIR generally agree with the theoretical predictions of this report. However, an improved automatic gain control system is needed to overcome the "blinking" problem of present-day FLIR sensors during aircraft turns or banking maneuvers. A conceptual design of an improved two-level automatic gain control system is described. The major problem in developing a FLIR flight sensor appears to be in displaying the sensor's image at unity magnification within the limited cockpit space, rather than in the design of the sensor-head itself. 66 pp. Ref.

R-2785-AF Dyna-METRIC: Dynamic Multi-Echelon Technique for Recoverable Item Control. R.J. Hillestad. March 1982.

The Dyna-METRIC model was developed to study and predict the readiness of groups of aircraft squadrons as determined by a major subset of logistics resources, namely, those associated with component repair and resupply. This report describes the mathematical approaches to modeling the effects of spare parts supply, component repair, and related processes on combat capability. It does not describe the implementation of any specific version of Dyna-METRIC. Section II reviews the time-dependent pipeline equations. Section III describes time-dependent stockage and component-repair measures of performance. Section IV combines these measures to give aircraft capability measures. Section V introduces the pipeline model for indentured components, while Sec. VI describes the pipeline equations for the time-dependent, multiple-echelon model. Section VII describes the optimization techniques for supply requirements, and Sec. VIII describes the approach for limited service facilities. 94 pp. Bibliog.

R-2813-AF Effectiveness and Cost of Alcohol Rehabilitation in the United States Air Force. B.R. Orvis, D.J. Armor, C.E. Williams, A.J. Barras, D.S. Schwarzbach. December 1981.

Evaluates the scope and outcome of rehabilitation efforts, the success of the Alcohol Rehabilitation Program in identifying impaired persons for treatment, and the cost-effectiveness of different interventions. Conclusions are that clients show substantial improvement after treatment and that the less intensive treatments are as effective as more intensive interventions for persons with comparable impairment at admission. However, less than 10 percent of the problem population appears to be identified for treatment annually and the use of intensive interventions may be overemphasized. Recommendations are that identifications be increased and that the higher resultant costs be accommodated through greater use of the less intensive interventions. Other suggestions to optimize efficiency include assigning some clients to 14-day inpatient programs instead of 28-day programs; eliminating Awareness Seminar attendance for clients receiving more intensive services; emphasizing group counseling as opposed to individual counseling; and placing reasonable limits on the maximum number of counseling sessions that a client may attend. 216 pp. Bibliog.

R-2831-AF Acquisition and Support of Embedded Computer System Software. M. Davis, S. Glaseman, W.L. Stanley. September 1981.

Documents the initial results of work aimed at understanding the software life cycle and at identifying the resources the Air Force commits to its various phases. Examines some commonly held ideas about the development and support of embedded computer system (ECS) software. Seeks to develop an understanding of how ECS software is acquired and supported, to assess the characteristics of the ECS software support task facing the Air Force today and in the near future, and to illuminate emerging issues and possible problem areas. These subjects are examined primarily in the context of operational flight program and automatic test equipment software applications. 86 pp. Bibliog.

R-2837-AF Chinese Commercial Negotiating Style. L.W. Pye. January 1982.

This study analyzes Chinese commercial negotiating practices for two reasons. The first is to minimize future misunderstandings in such activities, and the second is to provide guidance for government-to-government negotiations. The research procedure used involved interviews with American businessmen and bankers with extensive experience in the China trade, and—in order to control for American cultural factors—interviews with comparable Japanese bankers and businessmen. What was learned from the experiences of businessmen is of value in government-to-government negotiations, even though there are substantial differences between commercial and diplomatic relationships. At present, both Beijing and Washington seek a more cooperative and complementary relationship. By better understanding the Chinese style of negotiating in the commercial realm, we should be able to avoid misunderstandings and achieve desired goals in the political realm. 109 pp.

R-2860-AF Combat Benefits of a Responsive Logistics Transportation System for the European Theater (U). M.B. Berman, M.J. Carrillo, J. Halliday, N.Y. Moore. December 1981. Secret.

(U) Investigates the value to USAFE of a responsive intra-theater spare-parts transportation system during a European conflict. It estimates the gain in combat capability (expressed in sortie-related measures) attributable to such a transportation system, and calculates the costs of several alternatives for moving spare parts. The authors assessed the current transportation system's ability to provide spare parts in combat. Limitations on the current system may be such that it could not provide efficient, continuous spare-parts support among bases for the first few weeks of a conflict in Europe, and its inadequacies would certainly affect sortie-generation rates. A responsive logistics transportation system, on the other hand, could significantly increase combat aircraft availability at a ten-year total cost of from \$60 to \$110 million—far less than the cost of beefing up stocks or repair capability at the theater bases. (See also R-2860/1.) 119 pp. Ref.

R-2860/1-AF Combat Benefits of a Responsive Logistics Transportation System for the European Theater: Executive Summary (U). M. B. Berman, M. J. Carrillo, J. Halliday, N. Y. Moore, J. E. Peterson. December 1981. Confidential.

The title of this document describes its content. 23 pp.

R-2861-AF Multinational Coproduction of Military Aerospace Systems. M. D. Rich, W. L. Stanley, J. L. Birkler, M. A. Hesse. October 1981.

Assesses cost and schedule implications of acquiring weapon systems using multinational coproduction by examining experiences accumulated in a large and diverse set of aerospace development and production programs. Describes and, where possible, quantifies marked U.S. and European differences in such areas as production scale, work-force policies, schedule philosophy, and manufacturing methods that are a key to understanding the special consequences of international involvement in U.S. weapons production. Discusses implications of U.S. and European differences for collaborative production programs. Examines in detail the cost and schedule implications of coproduction in the F-16 fighter aircraft program, one of the most ambitious collaborative efforts ever attempted by the United States. Concludes with findings and policy-related observations, some of which are specific to the F-16 program, and others which address more general issues associated with multinational coproduction. 147 pp. Bibliog.

R-2867-AF The Control of Alcohol Problems in the U.S. Air Force. D. J. Armor, B. R. Orvis, M. B. Carpenter-Huffman, J. M. Polich. December 1981.

An evaluation of the Air Force's Alcohol Abuse Control Program, aimed at reducing the incidence of alcohol problems and rehabilitating personnel who experience them. Important findings are: (1) Only about 10 percent of Air Force personnel with serious alcohol problems are identified and referred for rehabilitation. (2) The four-hour Education Seminars—the Air Force's major prevention effort—do not have a significant long-term impact on drinking behaviors or attitudes toward drinking. (3) Even for more impaired clients, outpatient counseling at local bases works as well as inpatient treatment at regional hospitals and is more cost-effective. (4) For less-impaired clients, the eight-hour Alcohol Awareness Seminars are more cost-effective than outpatient counseling, indicating that efficiency might be enhanced by eliminating Education Seminars and increasing Alcohol Awareness Seminars. (5) The importance of identification should be stressed at all command levels and stronger measures taken to overcome the social pressures that work against identification. 25 pp. Ref.

R-2886-AF The Dyna-METRIC Readiness Assessment Model: Motivation, Capabilities, and Use. R. A. Pyles. June 1984.

Logisticians must plan, in peacetime, for wartime. This report describes a computer model, Dyna-METRIC, that can help the logistician to forecast future performance and identify wartime logistics constraints. The report discusses the

model's general functional characteristics and capabilities, and a simple example is employed to demonstrate both the model's interfaces (input files and output reports) and its use in analysis, so that analysts can apply the model to specific problems. 113 pp. Ref.

R-2896-AF Costs, Productivity, and the Utilization of Physician's Extenders in Air Force Primary Medicine Clinics. J. L. Buchanan, S. Hosek. June 1983.

This report addresses the question of whether the extensive use of physician extenders—nonphysicians trained to perform some of the medical and administrative tasks traditionally performed by physicians—in Air Force hospitals is cost-effective. Specifically, it examines the productivity of extenders in outpatient care and the costs of procuring and using extenders. The authors focused on one type of extender, physician assistants (PAs), who are typically Air Force corpsmen with one year of classroom and one year of clinical training. The general conclusions were the following: In typical Air Force primary adult medicine clinics, PAs can substitute for physicians one-to-one for 80–90 percent of the patients whose problems lie within the PA's expertise. Relying on PAs to perform most of the primary medicine workload is currently cost-effective, and will remain so until the earnings of civilian physicians decrease markedly relative to the earnings of PAs. 68 pp. Ref.

R-2900-AF Tactical Air. Challenges for the Future: A Briefing (U). N. W. Crawford. September 1982. Secret NOFORN WNIINTEL.

(U) This report examines (1) future needs for tactical air in performing air-to-air and air-to-ground combat tasks and the ability of the programmed force to meet those needs; (2) future needs for improved sortie generation capabilities and basic options and the effects on aircraft design and development; and (3) weapon system acquisition strategies through which the force needs could be realized. It recommends a two-part acquisition strategy designed to preserve the greatest number of options and to result in the most advanced tactical air capability possible. 99 pp.

R-2907-AF The Sino-Soviet Rivalry and Chinese Security Debate. J. D. Pollack. October 1982.

This report describes and analyzes the policy implications of the shifting security and foreign policy concerns among China's leaders since the mid-1960s. Among these concerns, none has more profoundly affected Chinese policymaking than the deterioration and militarization of Sino-Soviet relations. This study traces the course of the conflict between Moscow and Beijing to indicate the increasing emphasis that both leaderships have placed on the national security aspects of their rivalry. Beijing's predominant security concern is to reduce (or at least to stabilize) the Soviet political and military threat to China. Several key policy considerations continue to be contentious issues within the Chinese leadership, including (1) China's effort to construct an anti-Soviet security coalition with the United States and other major powers; (2) a burgeoning pattern of economic, technological, and political links between China and the noncommunist industrialized world intended to facilitate China's modernization; and (3) periodic overtures to

the Soviet Union that test Moscow's willingness to negotiate key bilateral issues. 112 pp. Bibliog.

R-2908/1-AF A Strategy for Reforming Avionics Acquisition and Support: Executive Summary. J. R. Gebman, H. L. Shulman, C. L. Batten. July 1988.

This report is an executive summary of R-2908/2. 20 pp.

R-2908/2-AF A Strategy for Reforming Avionics Acquisition and Support. J. R. Gebman, H. L. Shulman, C. L. Batten. July 1988.

During combat, high-performance avionics equipment must deliver the full extent of its designed capabilities. Failure to meet this standard is most often caused by a hard-to-find performance-degrading fault. Persistence of such faults results from weaknesses in the processes for acquisition and support of avionics. This report offers a strategy of six proposals to correct these weaknesses: (1) accelerate repair-and-maintenance-related avionics technologies, (2) improve the ability to test avionics equipment, (3) provide more complete feedback on equipment performance, (4) adopt a maintainability indicator, (5) institute maturational development, and (6) reorganize the Air Force's avionics engineering resources. Maturational development calls for government funding and direction of a special development effort aimed exclusively at repair and maintenance of the most complex avionics subsystems. Results from exploratory applications of the concept to the fire control radars on the F-15 C/D and the F-16 A/B indicate that the Air Force most needs to improve the efficient removal of performance-degrading faults. 125 pp. Bibliog.

R-2913-AF Factional Politics in Syria (U). N. Shahgaldian. July 1983. Confidential.

(U) This report provides historical and cultural information on the diverse ethnic, religious, and regional factions in Syria; analyzes their role in Syria's internal and external politics; and outlines the implications of this unique political environment for both Soviet and U.S. policy for Syria. In considering the intricacies of Syrian factionalism, the report also analyzes the strengths and vulnerabilities of the current regime and the opposition movement. Section II provides a discussion of the circumstances that led to the emergence of subnational loyalties and that continue to sustain them and is followed by a description of the major factions, their political orientations and commitments, and an identification of the main causes of sectarian discontent. Section III considers the circumstances in which the minorities came to dominate the Syrian officer corps and the ruling Ba'th party. Section IV deals with the influence of internal factional rivalries on Syria's foreign policy in the region. 88 pp. Bibliog.

R-2923-AF Long- and Short-War Scenarios in Soviet Strategy for a Future World War (U). R. E. Gottemoeller, P. M. Kozar. July 1983. Secret NOFORN WNINTEL.

(U) Describes the theoretical basis of Soviet practice for sustaining strategic force operations by examining Soviet thinking on the duration of a future world war. Since the early 1960s, Soviet military theorists have officially stressed

that a world war involving strategic nuclear weapons will probably be short, and will lead to the final victory of socialism. This official emphasis has been hedged with the statement that resource stockpiles may permit the two sides to keep fighting for some time. Despite this unenlightening official position, Soviet strategic force missions have increasingly reflected a recognition that a future world war may be long and require enduring, survivable strategic nuclear forces. The Soviets do not seem ready to consider long-war scenarios in which Soviet forces lose the strategic initiative for long periods. From the evidence of their strategic mission structure, they nevertheless recognize that a future world war may vary in nature and duration. 42 pp.

R-2943-AF The Soviet Far East Buildup and Soviet Risk-Taking against China. H. Gelman. August 1982.

An examination of factors that have influenced the evolution of the Soviet force buildup in Siberia, Central Asia, and the Soviet Far East under the Brezhnev regime. The report also tracks the changing Soviet view of the risks involved in the use of force against the People's Republic of China during the buildup, the development of Chinese military programs, the changing Chinese political scene, and China's evolving relationship with the United States. To this end, the study examines Soviet behavior and probable calculations in the three short Asian military crises of the Brezhnev era in which the security interests of the United States, China, and the Soviet Union most sharply interacted: the 1969 Sino-Soviet border crisis, the 1971 India-Pakistan war, and the 1979 Sino-Vietnamese hostilities. Probable assumptions the Soviets hold regarding their present and future force structure in the Far East are outlined. The report concludes by weighing the security implications of three broad alternatives for Sino-U.S. relations over the next decade: the relations remain unchanged, sharply decline, or significantly improve. 138 pp.

R-2951-AF Weather Information in Tactical Air Tasking. Results of a NATO Command and Control Simulation: Weather and Warplanes IX (U). R. E. Huschke, W. E. Naslund. September 1983. Secret.

(U) An hypothesis was tested to determine if improved presentation and application of weather information at high decisionmaking levels in the daily tacair tasking cycle could improve the effectiveness of air-to-ground attack missions. The test was a NATO tacair command and control simulation in which weather-impact forecasts were applied according to different "policies." Results (air-to-ground attack success rates) were compared between current and advocated policies, with the latter showing consistent improvement over the former. It is concluded that the recommended approach to use weather information offers a potentially significant, "no-cost" improvement in tactical air combat effectiveness. 79 pp.

R-2954-DOS/AF A Strategy for Dealing with Cuba in the 1980s. E. Gonzalez. September 1982.

Cuba poses a threat that could, if unchecked, fundamentally alter the U.S. geostrategic position in the Caribbean Basin and cause severe problems in the event of a U.S.-Soviet conflict elsewhere. The complex dimensions of this chal-

lenge make effective, viable policy options toward the Cuban government imperative, but elusive. This report proposes a strategy for gaining and applying leverage over Castro to bring about needed changes in Cuban foreign policy. Part 1 of the study provides the background against which a new Cuban strategy must emerge. Part 2 discusses a possible leverage strategy against Cuba and demonstrates how it could exploit the Castro regime's vulnerabilities and core interests. The military dimensions of the plan are assessed and specific military policies are proposed. The report elaborates the additional political, economic, and diplomatic policies needed to ensure an effective strategy. Potential problems and questions for future study are identified. 133 pp.

R-2963-AF A Comparison of Methods for Improving U.S. Capability to Project Ground Forces to Southwest Asia in the 1990s. P. M. Dadant, A. A. Barbour, W. E. Mooz, J. K. Walker, Jr. November 1984. For Official Use Only.

Despite recent improvements, U.S. capability for rapid ground force deployment falls short of many possible demands. This report examines equipment changes in units to be moved and alternative additions of C-5Bs, C-17s, PD-214s as dedicated sealift ships, logistics surface effect ships, lighter-than-air ships, and prepositioning of equipment at land sites, on PD-214 ships, or on Mobile Operational Large Island (MOLI) floating airbases for improving that capability in the 1990s. It compares equal-cost buys for the time required to deploy up to five divisions and for risks in feasibility, flexibility, cost estimates, and port vulnerabilities. The analysis indicates that prepositioning of some kind is essential to very rapid deployment. Political realities and real costs of either land- or ship-based prepositioning may rule against it, but the MOLI presents an alternative that could satisfy these problems. The report also discusses some remaining problems and concludes that a mix of systems designed to capitalize on the advantages and compensate for the drawbacks of each is most likely to result in an adequate U.S. capability. 279 pp. Ref.

R-2994-AF Venezuela's Pursuit of Caribbean Basin Interests: Implications for United States National Security. D. J. Myers. January 1985.

Although considerable differences between the Caribbean Basin policies of the United States and Venezuela surfaced during the 1970s, congruent interests will continue to outweigh differences in the future. Venezuela has become one of three regional powers in the Basin. It pursues policies that largely parallel Washington's national security interests; these include political, economic, and territorial objectives. Security interests encompass defense of frontiers, neutralizing threats originating in the Basin, and maintaining an anti-guerrilla capability. 45 pp.

R-2997-AF/RC Geopolitics, Security, and U.S. Strategy in the Caribbean Basin. D. F. Ronfeldt. November 1983.

This study examines some operational military issues involving the Caribbean Basin, and it reflects the broader concern that answers to operational military questions should depend heavily on answers to more fundamental questions

about why and how the United States should be interested in this complex, unstable region. Based on an examination of current trends as well as historical experience since promulgation of the Monroe Doctrine, the study advances a conceptual framework that identifies underlying geostrategic principles for guiding U.S. policy in the Basin. The study then proposes specific measures for developing an integrated political, economic, and military strategy that would advance U.S. interests and meet the interests of Basin neighbors. 93 pp. Ref.

R-3000-AF Moscow's Lessons from the 1982 Lebanon Air War. B. S. Lambeth. September 1984.

This report reviews Soviet impressions of Israeli air operations during the 1982 Lebanon war. It evaluates a 1983 article published in *Soviet Air Force Monthly* (whose audience includes Soviet aircrews), that assesses the implications of the Israeli-Syrian air battles. For Western audiences, the article provides insights into how the Soviets have interpreted the Beka'a Valley experience. It appears that the Soviets have either deliberately misrepresented Israel's air combat results to their own pilots or else failed to comprehend the tactical lessons suggested by Israeli combat performance. 46 pp.

R-3004-AF New Defense Options for NATO (U). M. G. Weiner. April 1983. Secret.

(U) This report summarizes a briefing that describes three new defense options for NATO (forward response option, distributed area defense, fortified barrier defense) and some of the major issues associated with them. The analysis begins with an assessment of the effectiveness of the current concept in a conventional conflict. It then determines the augmentation in ground forces necessary to conduct a successful defense and looks sequentially at the three alternative concepts and what would be required to achieve the same result. Finally, the report compares the three concepts on the basis of cost and other grounds and draws some general conclusions. 22 pp. Ref.

R-3021-AF Introduction to the Subjective Transfer Function Approach to Analyzing Systems. C. T. Veit, M. Callero, B. J. Rose. March 1984.

The subjective transfer function (STF) approach is a method developed to evaluate Air Force command and control systems, and is applicable to other complex systems that are impossible to evaluate through traditional quantitative means. Based on the principles of hypothesis formulation and testing, the method incorporates features of the algebraic modeling approach to measurement where meaningful subjective scale values derive from tested theories. It also provides features for coalescing judgments obtained from different groups of system experts into an overall perceptual system outcome. This report introduces and is a primer of the STF method. It outlines the steps involved in the approach, describes how those steps can be accomplished, and discusses measurement principles and techniques to aid the reader's understanding of the basis for the approach. 54 pp. Bibliog.

R-3028-AF A Dynamic Retention Model for Air Force Officers: Theory and Estimates. G. Gotz, J. J. McCall. December 1984.

This report describes the theory and methodology for estimating the parameters of a dynamic retention model for Air Force officers. The model was designed to estimate voluntary retention rates under a broad range of compensation, retirement, and personnel policies. It describes the decisionmaking process of individuals making stay/leave decisions over time in an uncertain environment, which allows it to predict policy changes that have no historical analogues. The report presents the theory and estimated parameters of the model, compares actual retention rates and those predicted by the model and two competing models, and examines five illustrative changes in compensation policies. 86 pp. Ref.

R-3036-AF The Soviet Gas Campaign: Politics and Policy in Soviet Decisionmaking. T. E. Gustafson. June 1983.

This report uses the Soviet gas campaign to examine the capacity of Soviet decisionmakers to deal with the severe domestic and international economic problems they will face in the next two decades. In drawing the conclusion that the core of Soviet problems in economic decisionmaking is the malfunctioning of the planning system, the author gives details of Soviet economic planning, politics and policy, organizational and infrastructural issues of implementation, and industrial and technological issues. Because the planning system malfunctions, the author believes it fails to provide policymakers with a clear and integrated picture of the choices before them and to provide implementers below with a coherent and realistic blueprint of what they are to do. The Soviet gas campaign is a victim of this process. 118 pp. Ref.

R-3046-AF Techniques for the Analysis of Spectral and Orbital Congestion in Space Systems. A. L. Hiebert, W. Sollfrey. March 1984.

This report is a compendium of the techniques available for analysis of spectral and orbital congestion in space systems. The expansion of signal transmissions and orbiting objects could severely affect the frequency spectrum allocations, orbit assignments, and related earth segments of space systems. The treatment of these problems requires a set of analytical procedures, computer programs to apply these procedures to specific configurations, and a database to provide inputs to the programs. The proposed Space System Data Base will consist of electromagnetic and operational characteristics of active and projected U.S. and international space systems including related earth and airborne segments. More than 20 analysis and computation codes are described, with the presentation pitched to an engineer's or user's level. The projected capabilities will provide an essential national resource for management decisionmaking and architectural planning on space-related programs. 297 pp.

R-3060-AF Casualties, Public Opinion, and Presidential Policy During the Vietnam War. M. A. Lorell, C. T. Kelley, Jr., D. Hensler. November 1984.

This report examines the relationship between U.S. casualties and public support for U.S. military intervention in Korea and Vietnam, and concludes that a strong inverse relationship existed between the two. It also assesses to what extent concern over adverse public reaction to U.S. casualties and the resulting decline in public support influenced presidential decisionmaking with respect to military intervention in Vietnam, overriding purely strategic or military considerations. The research approach consisted primarily of interviews with senior Johnson Administration officials. It concludes that (1) limited wars often cost more and last longer than anticipated, (2) public support inevitably declines with mounting casualties, no matter what interests are at stake, and (3) democracies can't continue fighting limited wars indefinitely with steadily declining public support. It recommends that minimizing U.S. casualties should be a central objective in the formulation of new strategies, force configurations, and weapon systems for limited war contingencies. 109 pp. Bibliog.

R-3061-AF Dissent and Nationalism in the Soviet Baltic. A. R. Alexiev. September 1983.

Examines the evolution of Baltic dissent and nationalism in the 1970s and early 1980s, focusing on their determinants, significance, and potential for generating political instability in this important region of the Soviet Union. This is the region most directly affected by developments in Eastern Europe, and in turn it is the one most likely to affect Soviet policies in the area. The report focuses on Soviet policies and practices that are perceived as generating dissent and nationalist unrest in the Baltic republics and analyzes the scope and nature of, and constraints on, political and religious dissent there. Research for this study has included an extensive review of Western and Soviet literature and in-depth interviews with a number of recent emigres from the Baltic. 47 pp. Bibliog.

R-3079-AF The Use of Regional Projection Forces in the Middle East: Jordan and Egypt (U). M. E. Morris. March 1984. Confidential.

(U) The sequence of events in the Middle East in the past decade has changed American perceptions of the region's importance, with a consequent refashioning of strategic objectives there. It is now accepted doctrine that the United States has vital interests in the Middle East/Persian Gulf region that by definition have to be defended. Discussions in the defense community have revolved around the best means to protect these vital interests, politically and militarily. Most attention has been placed on building up U.S. forces for quick insertion into regional conflicts; much less attention has been paid to the use of indigenous forces. This report explores the ramifications of using forces from regional, Western-oriented states to help bridge the gap between U.S. foreign policy commitments and present military capabilities. Specifically, it examines the possibility of using hypothetical forces of Jordan and Egypt, either in conjunction with or in lieu of U.S. Central Command forces. The report is an attempt to expand the menu of options available to planners responsible for the protection of U.S. vital interests. Its intent is to broaden the decision base and to enrich the dialogue. 67 pp. Bibliog.

R-3085-AF British Nuclear Policymaking. C. J. Bowie, A. A. Platt. January 1984.

This study analyzes the domestic, political, economic, and bureaucratic factors that affect the nuclear policymaking process in Great Britain. Its major conclusion is that, although there have been changes in that process in recent years (notably the current involvement of a segment of the British public in the debate about the deployment of intermediate-range nuclear forces), future British nuclear policymaking will remain much what it has been in the past. Britain's long-standing resolve to have her own national nuclear force is largely traceable to her desire to maintain first-rank standing among the nations of the world in spite of her loss of empire. Financial considerations have always been important—so much so that they have usually dominated issues of nuclear policy. The executive branch of government, though not always united internally, dominates the nuclear policymaking process through the influence of secrecy, the civil service, and the two-party parliamentary system. The United States also heavily influences British nuclear policy through having supplied Britain since the late 1950s with nuclear data and components of nuclear weapon systems such as Polaris and, as currently planned, Trident. 84 pp. Bibliog.

R-3089-AF Growth Options for Closely Spaced Missile Basing (U). R. D. Shaver, D. C. McGarvey, J. T. Quinlivan. January 1984. Secret Restricted Data NOFORN WNINTEL.

(U) This report describes an analysis of the MX missile in the closely spaced basing (MX/CSB) mode. The study addresses the long-term deployment strategy for MX in this basing mode. Particular attention is paid to the growth options of either ballistic missile defense or proliferation of shelters as potential counters to technological evolution of the Soviet ICBM force. 222 pp.

R-3111-AF The Future of Soviet Policy Toward Japan (U). H. Gelman, P. F. Langer. May 1984. Confidential NOFORN Intelligence Information.

(U) This report examines the factors that have influenced Soviet policy toward Japan and the Japanese response to Soviet policy, and evaluates the possibilities for significant change over the remainder of this decade. The study weighs alternatives for Soviet conciliatory gestures toward Japan, as well as the prospects for increased Soviet pressures against Japan. It concludes that there is almost no chance that the Soviet Union will agree to return the four disputed Northern Territories to Japan. While the Soviets may offer some incentives to Japan to improve relations, they will probably increase efforts to intimidate Japan. 75 pp.

R-3112-AF Space Based Defense Against Ballistic Missiles (DABM) (U). R. A. Scheder, A. F. Brewer, J. R. Hiland, K. J. Hoffmayer, M. D. Miller, L. G. Mundie, J. H. Rosen, L. N. Rowell. May 1984. Secret Restricted Data.

(U) This study compares the relative performance, cost effectiveness, and robustness to Soviet countermeasures of five generic space-based systems (two projectile, three

beam) for defense against ballistic missiles (DABM) in the year 2000. The report's conclusions have important implications for selecting the proper defensive weapon mix and the proper ratio of research and development expenditures on beam and projectile weapons. 34 pp. Bibliog.

R-3113-AF Improving U.S. Air Force Readiness and Sustainability (U). M. D. Rich, W. L. Stanley. March 1984. Secret NOFORN WNINTEL.

(U) This report seeks to promote discussion of the way the Air Force develops its weapon systems, manages its support resources, and conducts its wartime logistics operations. It describes the enemy threat facing the Tactical Air Forces in the next several decades, how that threat affects the combat environments within which those forces will have to operate, how those environments should shape force characteristics, and the implications for various resource management functions. The central conclusion is that effecting the necessary improvements in readiness and sustainability will require fundamental changes in the way the Air Force perceives weapon system requirements, develops and procures those systems, manages logistics resources, and organizes and operates combat support systems. 25 pp.

R-3113/1-AF Improving U.S. Air Force Readiness and Sustainability. M. D. Rich, W. L. Stanley, S. Anderson. April 1984.

This is an unclassified version of R-3113.

R-3118-AF Soviet Sortie Generation Capabilities and Vulnerabilities (U). D. E. Lewis, R. M. Paulson, C. B. East, H. G. Massey, J. T. Quinlivan, J. C. Wendt. August 1985. Secret NOFORN WNINTEL.

(U) This report documents the findings of a Project AIR FORCE study designed to (1) estimate the sortie capabilities of Soviet fighter-bomber regiments, (2) assess the potential vulnerabilities of those regiments, and (3) determine how those vulnerabilities could best be exploited by an offensive counterair (OCA) campaign. Sortie rates were estimated through a simulation that integrated intelligence data on Soviet organizations and procedures, ground-attack aircraft, and support resources and manpower. The simulation was also used to evaluate U.S. OCA capabilities in reducing sortie generation at a sample Soviet airbase. The date of data cutoff is June 1983. The report summarizes and expands on the results presented in two related documents, N-1926 and N-2057. 63 pp. Ref.

R-3118/1-AF Soviet Sortie Generation Capabilities and Vulnerabilities (U). D. E. Lewis, R. M. Paulson, C. B. East, H. G. Massey, J. T. Quinlivan, J. C. Wendt. August 1985. Secret Intelligence Information NATO Releasable.

This is a NATO-releasable version of R-3118. 59 pp.

R-3121-AF Commercial and Military Communication Satellite Acquisition Practices. G. K. Smith, J. P. Stucker, E. J. Simmons. May 1985.

This study tests the contention that the commercial sector consistently manages acquisition programs better than the military, by examining management practices and program

outcomes associated with the acquisition of communication satellites by the Air Force and by the International Telecommunications Satellite Organization (INTELSAT). The study finds that the military and commercial programs are organized and managed in much the same way and that both produce well-functioning, useful spacecraft. Several significant differences in management practices and outcomes, however, suggest that the Air Force may be able to improve its acquisition activities. It concludes that, in carefully selected situations, there should be a place for the performance-oriented INTELSAT management practices. 115 pp. Bibliog.

R-3125-AF Concepts of Operations and USAF Planning for Southwest Asia. C. J. Bowie. September 1984.

This report illustrates the application of a framework that could lend greater coherence to U.S. security planning. It also attempts to provide policymakers with a broad overview of the contribution the U.S. Air Force could make in protecting U.S. and Western interests in Southwest Asia. This study concerns itself with the most demanding military problem—the possibility of a Soviet invasion of Iran aimed at securing control over the oil fields of the Persian Gulf. Section II discusses American national objectives in Southwest Asia and the broad national strategy the U.S. government has formulated to achieve these objectives. Section III examines the nature of the Soviet threat and provides some background on strategic considerations that influenced the development of U.S. military strategy. Section IV discusses U.S. military strategy for possible contingencies, the forces being considered for operations in this theater, and the programs initiated to support this strategy. Section V attempts to identify what specific military capabilities the Air Force should enhance or develop to better support U.S. strategies and national objectives. Section VI lays out in some detail a concept of operations for one of these capabilities, strategic mobility for tactical aircraft. 70 pp. Bibliog.

R-3133-AF The Lessons of Coalition Politics: Sino-American Security Relations. J. D. Pollack. February 1984.

This study assesses the efforts of the United States and the People's Republic of China (PRC) between 1978 and 1983 to develop a security coalition opposing the expansion of Soviet power in Asia. The expectations generated by the major breakthroughs in Sino-American relations during the late 1970s vastly outstripped the results. The shifts in Chinese security strategy revealed evidence of exaggerated expectations and mutual misperceptions between the United States and China, but no clear links between internal leadership alignments and the PRC's foreign policy orientation. The Soviet military buildup in Asia, although not oriented exclusively against the PRC, directly threatened Chinese security, and along with the Soviet political posture toward China helped limit Beijing's disagreements with the United States. Because the prospects for highly developed security ties were so limited, the United States continued to stress the indirect benefits enjoyed through improved Sino-American relations. Beijing seems likely to collaborate with the United States in the future and the United States

can contribute to the further development of Sino-American security ties. 132 pp.

R-3136-AF The Soviet Union and Eastern Europe: Options for the 1980s and Beyond. J. Van Oudenaren. March 1984.

This report examines the importance of Eastern Europe to the USSR, the Soviet approach toward the region in the past, and possible future short-term and longer-term Soviet policies toward Eastern Europe. It examines dilemmas facing the Soviet Union in Eastern Europe and the Soviet "preferred vision" for a European order that would overcome these dilemmas. It assesses the collapse of the Brezhnev policy toward Eastern Europe, Soviet assessments of its causes, and likely responses. 90 pp.

R-3154-AF Soviet Concepts for Theater War in Southwest Asia (U). Y. F. Fukuyama. September 1984. Secret NOFORN WNINTEL.

(U) This report analyzes Soviet strategic and tactical principles that would be pertinent to an invasion of Southwest Asia, focusing primarily on the design of a large-scale conventional Soviet invasion of Iran. Among his findings, the author concludes that (1) the Soviets will probably undertake an invasion with ambitious objectives, or not at all; (2) the tactics of mountain warfare require qualities of field leadership that are at odds with the Soviet tendency toward a high degree of command centralization and inflexibility of decisionmaking at lower echelons; and (3) the performance of Soviet combat forces in Afghanistan has not matched Soviet doctrine for mountain warfare. 87 pp. Bibliog.

R-3158-AF TWIRL: Tactical Warfare in the ROSS Language. P. Klahr, J. W. Ellis, Jr., W. D. Giarla, S. Narain, E. M. Cesar, Jr., S. Turner. October 1984.

This report describes TWIRL, a simulation of a primarily ground combat engagement between two opposing military forces. It was developed to further experiment with the ROSS language, an object-oriented simulation language that was successfully used to develop the SWIRL air battle simulation, and to develop a prototype simulation that could be used to explore issues in electronic combat. The authors describe the objects that comprise TWIRL and provide extensive examples of object behaviors to explain and illustrate the process of building a simulation in ROSS. 49 pp. Bibliog.

R-3159-AF The Future of Soviet-North Korean Relations. H. Gelman, N. D. Levin. October 1984.

This report examines factors that have influenced the Soviet relationship with North Korea to the present time, and evaluates the prospects for this relationship over the next decade. It attempts, in particular, to isolate and weigh those factors that could make for significant change, particularly those that could contribute to greater instability on the Korean peninsula. From the perspectives of both the Soviet Union and the Democratic People's Republic of Korea, the bilateral relationship has for many years been difficult and cool. There is reason to believe that we are entering a rather fluid and dynamic period that might present Moscow and

Pyongyang with both new dangers and new opportunities. From the North Korean perspective, the most volatile factor concerns perpetuation of the ruling regime. On the Soviet side, there are two factors that could impel the Soviet leadership to consider important changes in policy. One would be the possibility of obtaining concrete security benefits. The other factor would be a decision by the United States to use South Korea as a platform for long-range theater nuclear weapons directed at the Soviet Union. 53 pp.

R-3160-AF ROSS: An Object-Oriented Language for Constructing Simulations. D. McArthur, P. Klahr, S. Narain. December 1984.

This report provides an overview of ROSS, an object-oriented language currently being developed at RAND. The goal of ROSS is to provide a programming environment in which users can conveniently design, test, and modify large knowledge-based simulations of complex mechanisms. Object-oriented programming languages, and ROSS in particular, enforce a message-passing style of programming in which the system to be modeled is represented as a set of objects and their behaviors (rules for object interaction). This style is especially suited to simulation, since the mechanism or process to be simulated may have a decomposition that maps naturally onto objects, and the real-world interactions between the objects may be easily modeled by object behaviors and object message transmissions. In addition to describing some of the basic ROSS commands and features, the report discusses some software that interfaces directly with ROSS, including a sophisticated screen-oriented editor and a color graphics package. Facilities for browsing among objects and their behaviors are also described, and examples of browsing and editing are presented using SWIRL, a military combat simulation written in ROSS. 28 pp. Ref.

R-3164-AF Theater and Intercontinental Nuclear Weapon Employment in a NATO-Warsaw Pact General War: Contributions of NATO's Nuclear Forces to Deterrence (U). T. M. Parker. October 1984. Secret Restricted Data NOFORN WNINTEL.

(U) Estimates of the survival of opposing ground, air, and land-attack nuclear forces in a general war between NATO and the Warsaw Pact that includes combat in Central Europe and the Balkans, and the hypothetical use of nuclear weapons in these and other areas at critical times during the war are used (1) to assess the contributions of NATO's nuclear forces to deterrence of Warsaw Pact conventional and nuclear attacks in North America; (2) to assess the contributions of specific theater and intercontinental forces to deterrence; and (3) to identify critical problems in maintaining deterrent capabilities. The analysis deals with all land-attack nuclear weapons that might be used in a NATO-Warsaw Pact war and considers all land-based combat forces as possible targets for nuclear weapons. The data on which this analysis is based are presented in RAND Note N-2098. 189 pp. Ref.

R-3185-AF Retention of Volunteer Physicians in the U.S. Air Force. V. L. J. Daubert. December 1984.

This study examines the implications of the retention behavior of Air Force volunteer physicians on the Air Force's physician procurement policy. It examines the potential of the volunteer program to become a major and, perhaps, the principal source of physicians based on the retention behavior of volunteer physician accessions from FY 1975 to FY 1982. The analysis suggests that about one-half of the FY 1987 authorized Air Force physician stock might be supported by the direct recruiting program for all groups except medical subspecialists. Predicted retention varies by specialty group, training, and grade (age): (1) young board-certified surgeons and obstetricians, both U.S.- and foreign-trained are least likely to be retained under current conditions and are most responsive to an increase in military pay; (2) foreign-trained hospital-based physicians without board certification have the highest predicted retention rate; (3) foreign-trained subspecialists and surgeons are retained at a lower rate than U.S.-trained physicians in this group; and (4) volunteer retention increases with the physician's military grade. 71 pp. Ref.

R-3189-AF Challenges to Soviet Control in Eastern Europe: An Overview. J. F. Brown, A. R. Johnson. December 1984.

This report summarizes and develops the findings of a project that examined the security issues posed for the United States by the likely evolution of the Soviet Bloc during the 1980s and beyond. Primary emphasis was placed on the political, economic, and social challenges to Soviet interests in Eastern Europe, as the framework for appraising the extent to which East European military forces can augment Soviet military capabilities in the late 1980s and the degree to which the Soviet army can operate in Eastern Europe unconstrained by local developments. Among the authors' conclusions are the following: (1) Poland has been pacified but not "normalized"; latent and active opposition continues. The process of pacification has made the army the real locus of power. (2) Poland and Romania are in economic crisis, and economic problems are severe throughout the region. Nevertheless, the East European economies have developed to the point where they have no chance of improved performance if they are cut off from the international economy. (3) The decline of consumerism will contribute to social ferment and working-class frustration. (4) The USSR and local leaderships in Eastern Europe will attempt to muddle through by pursuing conservative and repressive, rather than adaptive, status quo policies in the face of greater social ferment. 43 pp.

R-3190-AF The Challenge to Soviet Interests in Eastern Europe: Romania, Hungary, East Germany. F. S. Larrabee. October 1984.

This report examines socioeconomic and political developments in Romania, Hungary, and East Germany. It analyzes the viability of Romania's autonomous position within the Soviet Bloc. It considers the present and future viability of the "Hungarian model," Hungary's decentralized and less repressive economic and political system. It examines domestic East German developments, especially

the strengthening in the GDR of German national consciousness. In each country discussion, the emphasis is on examining domestic factors which may lead to new challenges to Soviet interests in Eastern Europe in the future. The study's findings suggest that in the next decade the Soviet Union will be challenged to maintain control over its East European alliance during a period when economies are cooling and leadership is changing. Simply "muddling through," as Brezhnev did in his last years, will not be sufficient. In the absence of a serious restructuring of its relations with its East European allies in the next decade, Moscow will risk the prospect of greater instability and unrest. 118 pp.

R-3198-AF West German Policymaking and NATO Nuclear Strategy. J. VanOudenaren. September 1985. For Official Use Only.

This report examines the policymaking processes of the Federal Republic of Germany (FRG) that relate to NATO nuclear policy. The study reviews these processes and the biases and traditions that particular government bureaucracies, as well as the political parties and nongovernmental interest groups, bring to nuclear weapons and related defense issues. It emphasizes the events of the last several years and the controversy surrounding the deployment of new U.S. missiles in the FRG, but also attempts to look beyond those events and predict future German responses to nuclear issues that may arise. In view of the domestic situation in the FRG, the study finds that U.S. policymakers can expect that (1) West German political leaders will be extremely reluctant to make difficult decisions in the nuclear area for the next several years; (2) even German political leaders who agree on the need to make NATO nuclear forces more "credible" will not support innovations on the U.S. side that are perceived as directed toward "warfighting"; and (3) German political leaders will maintain pressure on the United States to pursue political detente with the Soviet union. 147 pp. Bibliog.

R-3202-AF Reconciling Air Force Physicians' Peacetime and Wartime Capabilities: Demonstration of a Workforce Design Methodology. S. Hosek, J.L. Buchanan, G. A. Goldberg. August 1985.

This report documents a project to investigate alternative ways of bridging important differences between the Air Force Medical Service's peacetime and wartime missions. It uses information from a RAND survey of Air Force physicians' wartime skills and a mathematical programming model. It summarizes the model, documents the results of the skill survey, describes criteria for joint-mission medical manpower planning, and uses the model to analyze the effect of wartime cross-specialty substitution and peacetime resource constraints on physician capability. Among the conclusions suggested by the research are the following: (1) a wartime substitution policy based on the current tri-service substitution list could substantially improve wartime capability; (2) additional improvements would result if the tri-service list were revised in accordance with survey results; and (3) well-designed substitution roles for nonsurgeons can free surgeons to spend most of their time in surgery. 151 pp. Ref.

R-3208-AF Constraints on U.S. Strategy in Third World Conflict. S. T. Hosmer. September 1985.

This report assesses the military and political constraints imposed on U.S. strategy and combat operations in past Third World conflicts and crises. It also explores the implications of such constraints for the design of strategies to meet future communist challenges and identifies the requirements that particular constraints may pose for Air Force missions. The motivations that lead decisionmakers to constrain U.S. military responses stem primarily from the concern to control the risks of military conflict with the USSR, limit civilian and U.S. military casualties, seek negotiated solutions to conflicts, and accommodate the policies of other nations. Likely constraints must be taken into account in future U.S. intervention decisions and contingency planning. The United States must pursue strategies that will force early war termination and allow it to enforce the subsequent peace. The Air Force must anticipate being called upon to generate the military leverage to force war termination and to provide tactical air support to indigenous forces. 136 pp. Ref.

R-3208/1-AF Constraints on U.S. Strategy in Third World Conflict: Implications for Certain Contingencies (U). S. T. Hosmer. September 1985. Confidential.

(U) This report, a classified version of Part II of R-3208, contains classified or sensitive materials dealing with possible U.S. military responses to contingencies in Iran, South Korea, and Southeast Asia. 18 pp.

R-3213-AF Weather Probabilities Related to Soviet Tactical Air Operations in the NATO Central Region: Weather and Warplanes X (U). R. E. Huschke. March 1987. Secret NOFORN WNINTEL.

(U) Soviet air operations in the NATO Central Region are vulnerable to degradation due to weather. This report quantifies weather effects in the context of a presumed Soviet air operations plan, often described as a "massed conventional air attack," the objective of which is the reduction of NATO rear-area assets. The author divides each of four east-west corridors spanning the inter-German border into ingress, defense-suppression, and target sectors. He calculates a large variety of good/marginal/bad weather probabilities, structured for operational relevance, within and among sectors and corridors; and he stratifies the probabilities by month and time of day. In addition, he examines interannual weather variability, and gives frequencies of "runs" of good or bad weather. Study results quantify the significant weather problems faced by the Soviets in attempting to execute this idealized air attack plan. (See also R-2951.) 300 pp.

R-3255-AF Aircraft Airframe Cost Estimating Relationships: Study Approach and Conclusions. R. W. Hess, H. P. Romanoff. December 1987.

This report presents generalized equations for estimating the development and production costs of aircraft airframes. It provides separate cost estimating relationships (CERs) for engineering, tooling, manufacturing labor, and quality-control hours; manufacturing material, development sup-

port, and flight-test cost; and total program cost. The CERs, expressed in the form of exponential equations, were derived from a database consisting of 34 military aircraft with first flight dates ranging from 1948 to 1978. In addition to the basic objective of developing an updated set of airframe CERs, the study also examined three specific possibilities for improving CER accuracy: (1) stratifying the full estimating sample into subsamples representing major differences in aircraft type; (2) incorporating variables describing program structure and airframe construction characteristics; and (3) for the fighter aircraft only, incorporating an objective technology index into the equations. 95 pp. Ref.

R-3264-1-AF Double Vision: French Air Force Doctrine and Combined Tactical Operations in NATO (U). M. A. Lorell. October 1986. Secret NOFORN WNINTEL.

(U) This report, part of a larger effort to improve understanding and cooperation between NATO air forces and the U.S. Air Force, examines the doctrine and operational styles, force structure and capabilities of the French Air Force (FAF). In particular, it considers the ambiguous France-NATO relationship and its effect on FAF tactical operations within NATO; French nuclear doctrine and its effect on FAF tactical capabilities and operations within NATO; and FAF operational and tactical doctrine and operating styles as they apply to combined conventional operations in the Central Region. The findings suggest that, despite the official French security doctrine that emphasizes independent self-defense, the FAF believes that relations and coordination with other NATO air forces in general, and the U.S. Air Force in particular, are excellent; furthermore, it strongly desires to improve relations and coordination even further. 103 pp. Bibliog.

R-3265-AF Reducing the Air Force Male Enlistment Requirement: Effects on Recruiting Prospects of the Other Services. R. Buddin, C. J. Witsberger. March 1985.

If the Air Force filled a larger share of its enlistment requirement with women, how many of the displaced male Air Force recruits would join the Army, Navy, or Marines instead? This is the key question raised by a Congressional proposal calling upon the Air Force to make a rapid increase in the number of its female nonprior service enlistees. The proposal is intended to increase the numbers of high-quality male personnel available to the Army. It would help the Army if young male Air Force accessions consider the other services to be close substitutes and would enlist in another branch of the armed forces even if denied their first service choice. This study examined individual intentions and individual behavior, and used a multivariate model to predict the likelihood of an individual's choosing a particular service or civilian alternative. It concludes that, if the Air Force reduced its male enlistment requirement, most of the displaced male Air Force recruits would choose to remain civilians. Few would enlist in other service branches. 43 pp. Bibliog.

R-3268-AF The Soviet State Planning Committee (Gosplan) (U). A. S. Becker. November 1985. Confidential NOFORN WNINTEL.

(U) This report describes the structure and functioning of the USSR State Planning Committee (Gosplan), the Soviet Union's chief central planning agency. It focuses on Gosplan as an organization and on its role in Soviet high-level economic decisionmaking. Recent changes in Gosplan's authority and structure suggest the potential for a more significant Gosplan role in central planning. Especially if the promise of program planning is fulfilled, Gosplan might well become, as its chief has claimed, "the country's chief economic staff." Nevertheless, important systemic constraints remain on the effectiveness of central planning, particularly the primitive tools of planning "from the achieved level" and the imperatives of short term planning and resource balancing. In Soviet economic organization, politics continues to dominate economics, making systematic longer-term planning haphazard. Moreover, the normal uncertainty about the permanence of institutional change in the Soviet Union is surely multiplied by the process of generational succession in Soviet political leadership that is now taking place. 73 pp.

R-3269-AF Air Force Outlay Control: Management Implications and Options. H. G. Massey, A. A. Barbour, E. Dews, L. D. Malmstrom, R. L. Petruschell, R. E. Stanton, J. J. Waters. November 1985.

This report documents a study of Air Force financial management options and management implications of the use of outlay controls in the U.S. government budget. It explores the possible range of outlay controls that might be instituted, examines constraints that the Air Force encounters in trying to manage programs within such controls, and suggests courses of action and an overall management strategy for effectively coping with outlay controls, should they be imposed. The report identifies three steps that would have to be taken in preparation for the institution of outlay controls: (1) initiate work to bring outlay planning considerations into the program planning and budgeting process (including improved forecasting and tracking methods); (2) identify intra-year adjustment measures and their effects, and establish a priority list for them; and (3) establish a central authority for deciding when to implement intra-year adjustment measures and which specific measures to use. 34 pp.

R-3276-AF Assessing the Benefits and Costs of Motion for C-17 Flight Simulators. J. R. Gebman, W. L. Stanley, A. A. Barbour, R. T. Berg, J. L. Birkler, M. G. Chaloupka, B. F. Goeller, L. M. Jamison, R. J. Kaplan, T. F. Kirkwood, C. L. Batten. June 1986.

This study examines the benefits and costs of incorporating a motion system in the C-17 flight training simulator, and it suggests a standard framework for assessing simulator fidelity requirements in general, and motion cueing alternatives in particular. Using a framework detailed in this report, the research assesses three simulator alternatives: a system having no motion, a system using hydraulic/pneumatic g-seats, and a system using a six-degree-of-freedom (dof) motion platform. If the Air force devises an adequate training syllabus for C-17 simulators and if the program plan ensures that adequate performance data are collected during development, the incremental costs of simulators using six-

dof motion platforms appear to be warranted when measured against the likely benefits from their use. Simulators with no motion systems, or those using g-seats, do not appear to be cost-effective for the C-17 training application. (See also N-2301, P-7256.) 43 pp. Bibliog.

R-3278-AF Neutralizing Soviet Projection Forces in the Far East (U). Y. F. Fukuyama, Y. Ben-Horin, C. H. Builder. September 1985. Secret NOFORN WNINTEL.

(U) This report analyzes three broad U.S. strategy alternatives aimed at neutralizing the threat posed by Soviet projection forces in the Far East. It begins by discussing basic assumptions concerning conflict in the Pacific, including such questions as the political-strategic context in which the question of neutralizing Soviet projection forces is most likely to arise; the probable postures of the other major powers, particularly Japan and the People's Republic of China; and the relationship of the Pacific to other conflict theaters. It then analyzes the full range of Soviet projection threats that can be expected in 1990, including order-of-battle data and the doctrine and missions likely to govern the use of Soviet forces. These alternatives are analyzed in terms of both their operational effectiveness and their political-strategic consequences, particularly with regard to overall U.S. objectives in a global conflict with the Soviet Union. (See also R-3279.) 40 pp.

R-3279-AF Uncertainty Hedging in the Pacific Theater (U). Y. F. Fukuyama, Y. Ben-Horin, C. H. Builder. September 1985. Secret NOFORN WNINTEL.

(U) This report identifies and analyzes strategy options to hedge against some of the uncertainties involved in the defense of the Pacific-East Asia region. Because of the many assumptions and uncertainties surrounding force structure and war planning in the Pacific theater, hedging against worst-case scenarios is not feasible. "Major assumption failure analysis" is presented as a way of planning against reasonable intermediate planning failures. This methodology is then applied to a hypothetical case in which the United States is denied use of Japanese bases in the context of a global conflict with the Soviet Union. (This case was selected for heuristic purposes only and not because it was regarded as likely.) The study examines the consequences of Japanese base loss and suggests several hedges that the United States could undertake to mitigate the consequences of such a planning failure. (See also R-3278.) 22 pp.

R-3302-AF International Terrorism: The Other World War. B. Jenkins. November 1985.

This report is intended to serve as a primer for Air Force officers who must gain a basic understanding of the phenomenon of terrorism. It addresses numerous issues touching on the definition, theory, tactics, targets, and effects of terrorism, and the threat that terrorism poses to the U.S. Air Force, which is both a potential target of terrorist actions and a potential instrument of preemptive retaliation. The author suggests that past doctrines, training, and practices do not apply in the war of terrorism. At the same time, we are not defenseless against terrorist attacks. They are not, and are not likely to be, seriously incapacitating. Terrorists can always inflict damage, but they cannot "win" un-

less they manage to throw their target into a state of hysteria. Despite their mobility, their fanaticism, their advantage of surprise, and their emotional impact, terrorists do not have the capability to inflict crippling damage on the U.S. military. However, the U.S. military will have to develop new capabilities and doctrines to meet the challenge. 29 pp.

R-3303-AF Obstacles to the Termination of Air Force Activities. P. T. Hill, T. K. Glennan, Jr., S. J. Bodilly. April 1986.

The requirements of the 1985 Gramm-Rudman-Hollings Act or other budgetary constraints could lead the Air Force to consider terminating some procurement and research-and-development programs. This report analyzes the obstacles to the Air Force's use of termination as a management option and suggests how the Air Force might surmount these obstacles. The analysis is based on a review of (1) the literature on the barriers to termination that private-sector firms and government agencies face in trying to terminate major activities; (2) the Air Force's planning and resource-allocation process; and (3) the experience of large private firms that had terminated or divested major businesses. The report neither advocates termination for its own sake nor argues for its use in a particular case. The Air Force may conclude that initiating its own terminations may be the best way to keep control over basic decisions about its missions and character. (See also N-2339.) 19 pp.

R-3304-AF Integrating Basing, Support, and Air Vehicle Requirements: An Approach for Increasing the Effectiveness of Future Fighter Weapon Systems (U). M. B. Berman, J. Halliday, T. F. Kirkwood, W. E. Mooz, E. D. Phillips, R. J. Kaplan, C. L. Batten. August 1985. Secret Intelligence Information.

(U) This report describes a new methodology for increasing the effectiveness of future tactical fighters that face growing enemy threats in Europe and the Third World. In contrast to traditional approaches, this methodology integrates changes in the design of air vehicles with changes in the basing and support systems they use. The report argues that designs for future fighters and major modifications to current fighters not only must consider air vehicle performance in the traditional way, but must also consider flexibility, mobility, sortie generation capability, aircraft ground survivability, vehicle cost, vehicle basing method, and support structure. Although the study tests its methodology using only preliminary data and is focused on a single scenario and theater, its findings demonstrate the usefulness of an analysis of this sort in strengthening the Air Force's ability to evaluate future fighter designs. (See also N-1985-1.) 53 pp.

R-3304/1-AF Integrating Basing, Support, and Air Vehicle Requirements: An Approach for Increasing the Effectiveness of Future Fighter Weapon Systems. M. B. Berman, J. Halliday, T. F. Kirkwood, W. E. Mooz, E. D. Phillips, R. J. Kaplan, C. L. Batten. August 1985.

This report describes and demonstrates a new methodology for increasing the effectiveness of future fighters that must face growing enemy threats in Europe and the Third World.

Unlike traditional methods, this new methodology integrates changes in the design of air vehicles with changes in the basing and support systems they will use. The methodology calls not only for such conventional measures as the speed, acceleration, altitude, payload, and maneuverability of the air vehicle, but also for such new measures as the flexibility, mobility, sortie generation capability, aircraft ground survivability, and cost of the air vehicle, its basing methods, and its support structure. (See also N-1985-1.) 54 pp.

R-3310-AF Soviet Policy Toward Western Europe: Objectives, Instruments, Results. J. Van Oudenaren. February 1986.

This report analyzes the objectives, instruments, and achievements of Soviet policy toward Western Europe. It focuses on the mechanisms used by the Soviet Union to pursue its objectives in Europe, including diplomacy, military power, arms control, the West European Communist parties, ties with the non-Communist left, propaganda, and trade. The author concludes that the Soviet Union has achieved mixed results in its policy toward Western Europe. While it has succeeded in helping to consolidate postwar gains, Soviet policy has not yet made a dramatic breakthrough toward its stated objective of fostering a system of "collective security" in Europe. Nevertheless, there is little evidence to suggest that failure to achieve these maximal goals has led the Soviets to rethink their objectives or lower their expectations. 118 pp. Bibliog.

R-3316-AF Soviet-West European Relations: Recent Trends and Near-Term Prospects. A. A. Platt. March 1986.

This report examines recent key developments and trends in Western Europe, with an emphasis on the past two years, as a backdrop to an analysis of present and prospective Soviet relations with the West. It identifies five possible Soviet policy options toward Western Europe in the near and the medium term: (1) continuation of the kind of wedge-driving policy it used during much of 1983; (2) a differentiated policy of better relations with the United States, and cool relations with Western Europe; (3) a policy of defiance toward the West; (4) pursuit of a broad-based neo-detente relationship with both Western Europe and the United States; and (5) a purposefully confrontational policy toward the West. The author suggests that three considerations will be central to the Soviet Union in determining which policy it pursues: (1) the possibility of gaining new concessions from the United States through the continued pursuit of its present policy course; (2) the degree of continued Atlantic Alliance unity over defense and arms control policies; and (3) the electoral prospects of anti-nuclear opposition parties in Western Europe in the late 1980s. In any case, the Soviet Union will not abandon its fundamental objectives in Europe. 50 pp.

R-3318-AF Variability in the Demands for Aircraft Spare Parts: Its Magnitude and Implications. G. B. Crawford. January 1988.

Mathematical models of the logistics system are used to determine spares requirements, and they play an important role in evaluating logistics policies. The kernel of many, if not most, of these models is the modeling of the failure process and the resulting series of random demands on supply and maintenance. This report describes the assumptions of these models and quantifies ways in which the behavior of the data differs from the assumptions of the models. The differences are pervasive and important. In addition, an examination of the number of parts in the repair pipeline over time reveals even more variability than does the number of demands over time. These observations have two important consequences: (1) excessive demand variability substantially reduces the confidence we can put in our requirements and capability assessment models, and (2) highly variable repair pipelines with means larger than assumed by requirements models have a damaging effect on aircraft availability and wartime readiness. Depot policies, decisions, and goals should be aimed at reducing the number of parts in these pipelines and increasing aircraft availability and wartime readiness. 88 pp. Ref.

R-3332-AF The Impact of Eastern Europe on Soviet Policy Toward Western Europe. A. R. Johnson. March 1986.

This report examines the ways in which Soviet control of Eastern Europe has both contributed to and detracted from the Soviet Union's pursuit of foreign policy goals in Western Europe. In successive sections, it (1) reviews the highlights of past USSR-East European-West European interactions and outlines general characteristics of the triangular relationship; (2) examines the impact of the Polish crisis; and (3) traces the East European foreign policy activity related to NATO's 1983 decision to deploy intermediate-range nuclear forces and analyzes the emergence of a group of East European states—East Germany, Hungary, Bulgaria, and Romania—whose policies differ from those of the Soviets. The author suggests that, while Eastern Europe serves as a constraint on Soviet relations with Western Europe, Western Europe also acts as a constraint on Soviet policy toward Eastern Europe. 79 pp.

R-3333-AF Improving Operational Suitability Through Better Requirements and Testing. W. L. Stanley, J. L. Birkler. November 1986.

This report proposes prescriptive actions that could increase the contribution made by requirements and test-and-evaluation (T&E) aspects of the weapon system acquisition process to the fielding of more operationally suitable Air Force systems. Actions are needed that will (1) correct chronic problems in the expression of operational suitability needs and requirements, (2) address the problem of fragmented operational requirements documentation, (3) expand contractual accountability for reliability-and-maintainability and logistics-support characteristics, (4) adjust acquisition policies to enhance T&E's contribution to decisionmaking and to the identification and correction of deficiencies, and (5) structure tests to demonstrate new operating concepts and capabilities. These actions could facilitate the consideration of suitability factors in acquisition process activities that address difficult tradeoffs among

operational suitability, functional performance, cost, and development time. 104 pp. Ref.

R-3336-AF Implications of Changes in Nuclear Posture for NATO's Dual Capable Aircraft (U). R. J. Hillestad, M. F. Lawrence, J. A. Thomson, A. A. Barbour. March 1987. Secret Formerly Restricted Data NOFORN WNINTEL.

(U) For over twenty years, NATO's dual capable aircraft (DCA) have been an important element of its theater nuclear forces. During this time the alert, operational concepts for the nuclear mission and the number of assigned aircraft have changed very little. This report describes the current DCA posture and operating concepts and discusses several related issues, including (1) manpower and training costs of DCA, (2) conventional wartime sortie generation capability, (3) prelaunch survivability of DCA, and (4) political benefits and costs of changing the DCA nuclear role. It then presents three alternatives to the current posture: streamlining the current warning system to increase prelaunch survivability, reducing or eliminating peacetime alert, and reducing or eliminating the DCA nuclear mission. Finally, the report analyzes, where possible, the effects of these changes on each of the issues introduced above. 48 pp. Bibliog.

R-3340-AF Soviet Long-Range Cruise Missiles: Threat and Response—Summary of Findings (U). R. E. Gottemoeller, P. A. Wilson. October 1987. Secret NOFORN WNINTEL.

(U) Since the early 1980s, the Soviets have shown renewed interest in long-range land-attack cruise missiles. This interest has resulted in two new classes of cruise missiles: one is similar to the U.S. Tomahawk-class cruise missiles; the other is larger. This report summarizes the findings of a study that examined (1) the missions that the Soviets might envision for these modern cruise missiles and (2) the countermeasures that the United States should consider to neutralize the threat the missiles can impose on the continental United States. The focus of the study was a near-term period extending to 1995. Thus, it only considers Soviet missile systems and U.S. countermeasures that will be available for deployment by 1995. 13 pp.

R-3342-AF Personnel Management in the Military: Effects of Retirement Policies on the Retention of Personnel. R. Y. Arguden. January 1986.

Many studies of the military retirement system are based on models whose structures are likely to be changed by the policy interventions that they analyze. Such models could lead to seriously biased predictions of the retention effects of alternative retirement systems. This report examines the adequacy of the existing retention models for retirement policy analysis, quantifies their limitations, suggests improvements, and develops a simulation methodology to test the suggested and future improvements. It also examines the importance of paying analytical attention to the inputs of the retention models. 203 pp. Bibliog.

R-3349-AF Soviet Central Decisionmaking and Economic Growth: A Summing Up. A. S. Becker. January 1986.

This report summarizes important characteristics of Soviet economic decisionmaking, examines Soviet prospects for economic growth under Gorbachev, and draws some policy implications for the United States. The author suggests that military development pressure is the most reliable U.S. bargaining tool, but cautions that its validity depends on continuation of Soviet economic stringencies and a Soviet belief that the U.S. threat can be rendered manageable. Therefore, U.S. military pressure should be balanced by a readiness to define conditions of strategic parity and to reach workable agreements translating such criteria into reality. 53 pp.

R-3354-AF Factors Affecting the Development of a Space Surveillance and Tracking System (U). D. S. Rubenson, J. G. Bolten, J. L. Bonomo, K. P. Horn. July 1986. Secret NOFORN WNINTEL.

(U) This report documents a policy briefing on the Space Surveillance and Tracking System (SSTS), which may have two military missions. A near-term application involves using SSTS to provide surveillance for Air Force space defense. The second potential application is mid-course surveillance for a space-based ballistic missile defense. The report considers (1) whether the United States can establish the requirements for an SSTS capable of ballistic missile defense and work toward designing that system without first deploying an interim system of less capability; (2) whether a near-term SSTS is a necessary learning step before developing a system capable of ballistic missile defense; and (3) whether there is sufficient rationale to develop a near-term SSTS for the Air Force space defense mission in the absence of a long-term ballistic missile defense objective. 33 pp. Ref.

R-3356-AF The Royal Air Force and Combined Operations in Europe: Specialization and Decentralization (U). C. J. Bowie. September 1986. Confidential NOFORN.

(U) This report provides an overview of Royal Air Force (RAF) concepts for tactical air operations in the European theater. It attempts to provide insights into the RAF's operational philosophy by examining its history, the evolution of its force structure, and the general thinking of its officer corps. 60 pp. Bibliog.

R-3362-AF Airbase Defense with High-Power Microwave Weapons (U). L. G. Mundie. August 1988. Secret NOFORN WNINTEL.

(U) This report examines the utility of high-power microwave (HPM) weapons for airbase defense. It considers the parameter tradeoffs for an HPM weapon employed in the airbase defense role, selects a baseline system, and estimates its performance. The characteristics of the baseline HPM weapon system complement those of existing airbase defense weapons so that, subject to the resolution of a number of uncertainties, the authors conclude that it may be

a valuable supplement to, or replacement for, present systems. 43 pp. Bibliog.

R-3368-AF The Soviet Economic Dilemma of Eastern Europe. K. W. Crane. May 1986.

This report examines probable changes in Soviet economic policies toward Eastern Europe during the next decade. It studies the issue of Soviet economic subsidies to Eastern Europe and explores several hypotheses that could explain why they have been granted. Finally, it discusses ways in which Soviet willingness to subsidize Eastern Europe will likely be affected by increased Soviet economic stringency, along with the possible repercussions of a decline in subsidies for East European economies. The study concludes that the Soviet Union will continue to use an awkward, expensive system of trade within the Council for Mutual Economic Assistance to buttress its important strategic, ideological, bureaucratic, and political stakes in the region. 70 pp. Bibliog.

R-3369-AF Strategic Defenses and the Transition to Assured Survival. G. A. Kent, R. J. DeValck. October 1986.

This report details the anatomy and calculus of the ballistic missile portion of the transition to a robust nationwide strategic defense posture, as proposed by President Reagan on March 23, 1983. To provide insight into the policy issues surrounding the transition, the authors develop an analytic format based on ballistic missile "defense potential." The defense potential format demonstrates that, if highly survivable strategic defenses were deployed as an adjunct to current superpower ballistic missile forces, the United States could make the transition to the President's goal of assured survival from ballistic missile attack without having to pass through a period during which either the United States or the Soviet Union would have great incentive to launch a first strike against the other. However, if the defenses are vulnerable to attack and/or if both superpowers continue to deploy weapons capable of destroying hard targets but fail to adopt corresponding offensive force survivability measures, a stable transition would become less likely. 57 pp.

R-3382-AF/A Joint Air Defense: An Assessment of the Planned Patriot/F-16 Mix in Central Europe (U). P. M. Dadant. July 1987. Secret NOFORN WNINTEL.

(U) This study assisted an Army/Air Force Joint Working Group charged with performing a net sensitivity analysis of the preferred mix of area-defense surface-to-air missiles and air defense aircraft. It used RAND-developed models to investigate the sensitivity of the 1993 U.S. Patriot/F-16 mix in Central Europe to changes in estimates of the air defense effectiveness of these two systems and of some other parameters (e.g., aircraft sortie rates and effectiveness in other missions). Given the uncertainties inherent in these estimates, the programmed mix of these weapons appeared to be a well-balanced compromise. The programmed mix was found to perform comparably to the preferred mix except in cases where the air defense effectiveness estimates of the two systems were highly optimistic or highly skewed. If these estimates are highly optimistic, the preferred mix should be heavier than the programmed mix in the more

flexible weapon, the F-16. If the estimates are skewed, the preferred mix should be heavier in the more effective weapon. However, the war's progress would be more sensitive to other factors than to changes in the Patriot/F-16 mix. 135 pp. Ref.

R-3384-AF Italian Tactical Combat Aviation and Its Changing Role in NATO's Southern Region (U). M. A. Lorell. May 1987. Secret NOFORN.

(U) This report examines and assesses the operational style, force structure, and capabilities of the Italian Air Force within the context of overall Italian security policy. This research is part of a larger RAND effort aimed at improving understanding and cooperation between NATO air forces and the USAF. The overall objective is to enhance the wartime effectiveness of combined NATO conventional (non-nuclear) air operations by isolating potential problems that may arise from national differences, inconsistencies, or implementation problems, and to recommend policy measures that mitigate these problems. (See also R-2596, R-3264, R-3356, R-3461.) 40 pp. Bibliog.

R-3385-AF The Development of NATO Tactical Air Doctrine, 1970-1985. D. J. Stein. December 1987.

This report analyzes the key doctrinal and operational interests of allied services in NATO. It addresses the major issues in the development of NATO tactical air doctrines from 1970 to 1985 and considers why progress in developing NATO air doctrine was often impeded by competing interests among allied nations and their individual services. The author suggests that improving NATO's warfighting capabilities and enhancing its force effectiveness cannot be accomplished solely by modifying its air doctrine. Disparate national, service, and budgetary interests underscore competing doctrinal preferences among the allies. A U.S. Air Force regional air doctrine consistent with *NATO Tactical Air Doctrine* (Allied Tactical Publication No. 33) could conceivably be the most useful response to the problems of reconciling Air Force and NATO doctrinal imperatives. 69 pp. Bibliog.

R-3389-AF Dyna-METRIC Version 4: Modeling Worldwide Logistics Support of Aircraft Components. K. Isaacson, P. M. Boren, C. L. Tsai, R. A. Pyles. May 1988.

This report describes Dyna-METRIC Version 4, a computer model that relates logistics resources and policies to wartime readiness. Developed for the use of logisticians to improve wartime logistics support, Dyna-METRIC assesses the effects of wartime dynamics and repair constraints and provides operational performance measures, problem detection, and spares requirements. Version 4 consists of five programs that provide for three echelons of interaction (including the depot-to-theater link) and three levels of components (for which demand processes, repair processes, and spares levels may vary). Dyna-METRIC portrays component support processes as a network of pipelines through which aircraft components flow as they are repaired or replaced within a single theater. Using the sum of all the pipeline segments, Dyna-METRIC determines the complete probability distribution for the number of parts in repair and on order. Combining the distributions for all components

provides the estimate of aircraft availability and sorties. 212 pp. Ref.

R-3425-AF The Sensitivity of Aerospace Operations in the Year 2025 to Technology Breakthrough (U). J. A. Dewar, R. T. Berg, M. J. Hammer, M. Kamionski, T. F. Kirkwood, K. E. Phillips. October 1987. Secret.

(U) This report presents a methodology for assessing the potential effects of technological breakthroughs on aerospace capabilities, and it applies that methodology to Air Force operations in the year 2025. Using a procedure akin to sensitivity analysis, the authors identify two breakthrough areas as having the highest degree of influence: space transportation (spacelift and propulsion) and space power generation. The report also briefly characterizes the ways in which Air Force organizations will be affected by technological developments and recommends a strategy for dealing with these effects. 53 pp.

R-3430-AF Ground-Based Electromagnetic Guns as Antisatellite Weapons (U). L. N. Rowell, T. B. Garber, L. G. Mundie, R. A. Scheder. July 1988. Secret NOFORN WNINTEL.

(U) This report discusses the types of projectiles required for the antisatellite mission and the performance requirements for a ground-based electromagnetic (EM) gun weapon system. The threat is an assumed future constellation of Soviet satellites. Because the research on an effective EM gun and projectiles for this mission is at the early concept-development stage, results (i.e., the number of projectiles needed to hit the target satellite) are preliminary and incomplete. 85 pp. Ref.

R-3436-AF/A Intrepid Falcon: An Experiment in Contingency Gaming (U). M. E. Morris, C. H. Builder, W. M. Jones, D. A. Shlapak, R. Levine. August 1987. Secret NOFORN.

(U) In 1985, RAND researchers developed a political/military seminar-type game called "Intrepid Falcon," which was subsequently played in a foreign country by senior military officials from the United States and the host country. This report records the history of the game from the preliminary agreements under which it was commissioned to the design, testing, and actual play in the host country. Appendixes contain documentation of scenarios, move papers, and background information used in the game. 81 pp. Bibliog.

R-3437-AF Space Weapon Concepts (U). R. A. Scheder, A. F. Brewer, K. J. Hoffmayer, L. N. Rowell, J. H. Rosen, R. M. Salter, Jr. August 1987. Secret.

(U) This report describes a spectrum of futuristic space weapon concepts: rocket boosters, electromagnetic launchers, fire control for kinetic-energy impactors, TRIM, space-based lasers and X-ray lasers, neutral particle beam weapons, and microwave weapons. None of the weapon candidates exists today. Most have been extrapolated from laboratory hardware. Their demonstrated technical performance characteristics are often orders of magnitude less than their projected characteristics. Similarly, their projected weights and costs reflect an assumed accelerated march

of technology. The authors find that none of the weapon candidates violates physical principles, and all are evolutionary rather than revolutionary extrapolations of existing technology, thus permitting performance characteristics to be meaningfully projected to the year 2000. The authors also find that subsystem weights and complexities can be projected consistently enough to make relative, but not absolute, cost comparisons worthwhile. Each concept is found to have advantages and disadvantages that ultimately determine its effectiveness against a particular threat. 106 pp. Ref.

R-3439-AF A-10 Operations and the Battle for North Norway. J. G. Terry. January 1988.

This report outlines the strategic importance of North Norway to the outcome of any future NATO/Warsaw Pact war on the basis of its location adjacent to the western Soviet heartland, the major Soviet bases on the Kola Peninsula, and the Norwegian Sea. The report presents a scenario for a Soviet amphibious and land force attack upon the region, the object of which would be the control of the main air and naval bases in the region; and it discusses five missions that U.S. A-10 aircraft could perform to support the defense of North Norway. It concludes by recommending that (1) Alaska-based A-10 aircraft be selected to perform these missions because of unique similarities between the environments of North Norway and Alaska and (2) the present training of Alaska-based A-10 pilots be modified to prepare them for these missions. (See also N-2497-AF.) 39 pp. Bibliog.

R-3461-AF Canadian Tactical Airpower: Operational Philosophy and Concepts (U). C. J. Bowie. January 1987. Confidential NOFORN.

(U) This report provides a perspective on Canadian operational philosophies and concepts for tactical airpower in NATO's Central Region. It is based upon the voluminous historical literature concerning the Royal Canadian Air Force and Canadian Forces (CF), interviews with and end-of-tour reports by U.S. officers on exchange tours in Canada, and opinions solicited from Canadian officers serving in both Canada and Europe. The author notes that the CF operational philosophy reflects a unique mix of the views of the Royal Air Force and the U.S. Air Force, the two most politically powerful air forces in NATO. Nonetheless, the CF have developed their own unique approach, and their doctrinal viewpoint should be accommodated within the NATO framework so that the alliance can achieve the full combat productivity of the CF-18, one of the most versatile top-line fighters in NATO's inventory. 45 pp. Bibliog.

R-3474-AF Selecting a Decision Support System Generator for the Air Force's Enlisted Force Management System. R. G. Walker, R. S. Barnhardt, W. E. Walker. December 1986.

Many of the software requirements for a decision support system (DSS) are not specific to an application (e.g., database management and report generation). Developing the software to provide such general capabilities might take more effort than developing the software for the specific application. In order to facilitate the building of the Air

Force's Enlisted Force Management System, a general-purpose off-the-shelf software package (called a DSS generator) was acquired in which the specific system models could be embedded. This report explains how the DSS generator was obtained. It presents the objectives that were defined for the generator and the requirements that were derived from these objectives. It then describes the structured evaluation process that led to the ultimate selection. 41 pp. Ref.

R-3475-AF Recent Progress in Assessing the Readiness and Sustainability of Combat Forces. M. D. Rich, I. K. Cohen, R. A. Pyles. October 1987.

This report is based on testimony given by Michael Rich to the House Armed Services Committee's Subcommittee on Readiness in February 1986. It traces the evolution of RAND research on an important defense management problem: How to increase the capability of combat forces by improving the ability of combat commanders, resource managers, and planners to assess readiness and sustainability and to take appropriate action to strengthen both. The report describes the general challenge of assessing readiness and sustainability, discusses the present state of the art and its evolution, and finally, considers what the future holds. It also reflects a view that readiness and sustainability assessment is now a required and increasingly important element of day-to-day combat force operations, support system management, and planning for future forces and operations. 12 pp.

R-3482-AF Middle-Term Loss Prediction Models for the Air Force's Enlisted Force Management System: Specification and Estimation. G. M. Carter, M. P. Murray, R. Y. Arguden, M. Brauner, A. F. Abrahamse, H. Greenberg, D. L. Skoller. December 1987.

This study specifies equations for models that predict the loss and reenlistment behavior of airmen. The cohort models described here—where cohorts are defined based on an airman's position in his career—provide information about how airmen would respond to changes in economic conditions, military pay raises, and bonuses. Developed for the Air Force's Enlisted Force Management System, these models allow forecasts of the behavior of different demographic groups and people in different occupations. 83 pp. Ref.

R-3503-AF/DARPA High-Power Microwave Weapons: The Fratricide Issue (U). E. Bedrosian. October 1987. Secret.

(U) This report develops methods for assessing the fratricide (incidental damage to friendly electronic systems and personnel) associated with high-power microwave (HPM) weapons and applies them to two illustrative systems. First, the concepts of stress and susceptibility, which have been developed in high-altitude electromagnetic pulse (HEMP) research, are introduced and adapted to the fratricide problem. The HPM and HEMP threats are compared to identify areas of HEMP research that can be carried over to HPM work. Fratricide criteria for electronic systems and for humans are then developed by reviewing the available test

data. For electronic systems, ranges of vulnerability to interference and upset and to permanent damage are established; a single safe level is adopted for human exposure. Radiation from a wide variety of antennas is then examined and used to develop a family of radiation patterns suitable for fratricide analyses. Finally, the results are applied to two illustrative HPM weapon systems—one designed for airbase defense and the other for airborne use. 56 pp. Ref.

R-3504-AF Soviet Civil-Military Relations and the Power Projection Mission. Y. F. Fukuyama. April 1987.

This report considers ways that the Soviet Union's policy toward the Third World has been a factor in its civil-military relations. The report pieces together what we know about evolving Soviet military views on the Third World and tests the hypothesis that the military as an institution was in some way an advocate of intervention after the early 1970s. The author (1) provides a brief overview of the mechanics of Soviet decisionmaking on the Third World and of ways in which the military fits into the picture; (2) traces the ascending curve of military interest in the Third World, beginning with the Soviet Navy's pursuit of bases in the 1960s and the development by the early 1970s of the concept of a "liberating mission" for the Soviet armed forces as a whole; (3) discusses the subsequent downplaying of the "liberating mission" under the military leadership that assumed control in 1976; (4) analyzes the effect of the invasion of Afghanistan on the military's view of intervention in general and on civil-military relations; and (5) provides an overview of the evolution in Soviet military thinking about the Third World. The author concludes that Soviet military views of the Third World do not fit a simple pattern and that they represent a point of view on Third World issues distinct from that of the political leadership. 88 pp. Bibliog.

R-3508-AF The Military and Political Potential of Conventionally Armed Heavy Bombers. S. T. Hosmer, G. A. Kent. August 1987.

This report explores the major contribution that a conventionally armed heavy bomber force could make to U.S. national security. It examines (1) the potential military and political utility of a bomber force armed with modern conventional weapons and munitions, (2) the approach for obtaining the requisite capabilities for such a force, and (3) the implications of a conventionally armed bomber force for U.S. arms control policy. The authors believe that the U.S. Air Force should dedicate a force of approximately 75 to 100 heavy bombers (B-52s now and advanced technology bombers later) to conventional missions. To provide the standoff required for B-52s to operate in high-threat environments, the Air Force should develop and acquire long-range cruise missiles and equip these missiles on an evolutionary basis with modern sensors, on-board engagement systems, dispensers, and conventional munitions. 36 pp.

R-3521-AF The Soviet Civilian Leadership and the Military High Command, 1976-1986. J. R. Azrael. June 1987.

This report charts the stormy course of high-level Soviet civil-military relations from 1976 to 1986; and it assesses the sources, dynamics, and implications of the policy debates and political conflicts that have occurred between members of the civilian leadership and members of the high command. In particular, the study examines the civil-military tensions generated by escalating disagreements over doctrine and resource allocations and the ways in which these tensions have influenced and been influenced by factional struggles and personnel changes within both the civilian leadership and the high command. It also seeks to determine whether the severe tensions of the past decade are temporary aberrations or whether they are likely to persist—and, if they persist, what that might portend by way of continuity or change in Soviet policies and priorities. 48 pp. Bibliog.

R-3527-AF The Nordic NATO Air Forces (U). J. R. Lund. September 1987. Confidential NOFORN.

(U) The national and military strategies of Norway and Denmark derive from the commitment of these states to support the "Nordic Balance" by maintaining a low level of tension toward the Soviet Union. This report examines the forces and operational concepts of the air forces of these two countries. In particular, the author considers (1) the degree to which the Nordic Balance drives operational concepts and capabilities of the Royal Norwegian Air Force; and (2) how the Royal Danish Air Force interprets the Nordic Balance differently and has its own methods of achieving combat effectiveness despite resource constraints. He suggests that the air forces of both countries will continue to have limited capabilities because of deeply rooted fundamental constraints: the small size of the countries, the geostrategic importance of the Nordic Barrier, national commitments to social welfare systems, and the governments' commitment to a low-tension policy toward the Soviet Union. 42 pp. Bibliog.

R-3530-AF Procedures for Estimating Life-Cycle Costs of Electronic Combat Equipment. J. P. Large, A. A. Barbour, G. F. Mills. February 1988.

This report presents both a set of procedures for estimating the various elements of life-cycle costs and a computer cost model for integrating those elements in the context of a tactical fighter squadron. The emphasis is on providing an input to cost effectiveness studies, but information is presented that also permits an evaluation of future electronic combat (EC) equipment costs in the context of cost trends for various categories of equipment. Considerable effort was devoted to collecting procurement costs for EC equipment currently used by Air Force tactical aircraft. 77 pp.

R-3541-AF Ogarkov's Complaint and Gorbachev's Dilemma: The Soviet Defense Budget and Party-Military Conflict. A. S. Becker. December 1987.

This report attempts to illuminate the conflict within the Soviet Union between the Communist Party and the military high command over resource allocation in the early 1980s. It examines the measures of resource growth that the two sides could have used in the debate. It also considers Gorbachev's approach to the same problem in the last half

of the 1980s and the connections between the two episodes. The author suggests that, in the future, Gorbachev's ability to maneuver may be limited by the growing harshness of military-Party relations. Furthermore, his failure to make good on his promises could aggravate the military-Party conflict. 52 pp. Ref.

R-3550-AF The Strategic Defense Initiative in Soviet Planning and Policy. B. S. Lambeth, K. N. Lewis. January 1988.

This report analyzes the nature and depth of Moscow's concern about the Strategic Defense Initiative (SDI) and its implications for future Soviet responses. The authors consider the political-military and technical issues raised for the Soviets by SDI. The study assesses the Soviet declaratory stance on SDI; reviews the evolution and current state of Soviet attitudes toward homeland defense; summarizes key trends in Soviet antiballistic missile and antisatellite technology; considers the actual concerns that may underlie Moscow's propaganda line on SDI; reviews the range of technical responses the Soviets have said they might undertake; and examines the various political, strategic, institutional, and economic determinants that will shape whatever counter-SDI choices the Soviets ultimately adopt. 109 pp.

R-3584-AF Cost Estimates and Estimating Procedures in the IIR Maverick and AMRAAM Programs. J. P. Large, J. J. Angello, A. A. Barbour, H. G. Massey, S. A. Resetar. May 1988.

This report examines successive Air Force and contractor cost estimates in the Imaging Infrared (IIR) Maverick and Advanced Medium-Range Air-to-Air Missile (AMRAAM) programs. The research sought to determine why costs increased and, to the extent that cost growth was a result of poor estimating, how estimating procedures could be improved. Typically, estimates increase over time for many reasons: production quantity may increase, inflation rates may go up, production rates may go down, planned advances in technology may not occur on schedule, and system design may become more complex. If system designs change in important ways during development, it may not be reasonable to expect early estimates of schedule and costs to be reliable. The authors suggest that, before pouring additional resources into an effort to improve cost analysis procedures and organization, the Air Force should examine the actual function of independent cost analysis. 56 pp.

R-3587-AF The Muslims of ASEAN (U). G. K. Tanham, E. S. Wainstein. December 1987. Confidential Intelligence Information.

(U) This report discusses the implications for the U.S. Air Force and other U.S. interests of militant Islam in Southeast Asia. Within that framework, it examines Southeast Asian Muslim ties to and support from Middle East Muslims. The analysis focuses on four ways in which militant Islam in each of the ASEAN (Association of South East Asian Nations) states (Brunei, Indonesia, Malaysia, the Philippines, Singapore, and Thailand) might affect U.S. interests (1) as a destabilizing force in each ASEAN country; (2) as an agent whose Middle East ties affect foreign relations within ASE-

AN; (3) as an influence on ASEAN as an institution and on the foreign policies of the ASEAN states; and (4) as a direct threat to U.S. Air Force installations in the Philippines and elsewhere in the region. The authors conclude that the strong Islamic factor in the foreign policies of all the ASEAN states except Singapore may present problems for ASEAN solidarity and for the United States. At the present time, however, militant Muslims do not pose a direct threat to U.S. interests in the six ASEAN countries. (See also N-1971.) 59 pp.

R-3588-AF Gorbachev's Policies Toward Western Europe—A Balance Sheet. H. Gelman. October 1987.

Since coming to power, General Secretary Gorbachev has launched a diplomatic and propaganda offensive against the political foundations of Western Europe's nuclear deterrent and the European connection with the United States. He has, however, given clear indication that he considers his predecessors' campaign of threats and alarmist tactics in Europe to have been mistaken, and he has displayed willingness to make certain incremental retreats from past Soviet negotiating positions. But Soviet goals have not yet substantially changed. There are several factors favoring his purposes, notably his willingness to adapt Soviet negotiating strategy to the reality of defeat on the deployment of intermediate nuclear forces and his readiness to seek new ways of turning this defeat to Soviet advantage. However, there are several trends in Europe that are unfavorable to him. In particular, Gorbachev's internal political relaxation and his peace offensive toward Western Europe may pose dangers for the stability of the Soviet position in Eastern Europe. 75 pp.

R-3588/1-AF Gorbachev's Policies Toward Western Europe—A Balance Sheet: Executive Summary. H. Gelman. October 1987.

This report is an executive summary of R-3588. 16 pp.

R-3604/1-AF A New View of Weapon System Reliability and Maintainability: Executive Summary. J. R. Gebman, D. W. McIver, H. L. Shulman. January 1989.

This report is an executive summary of R-3604/2. (See also R-2908/1, N-2479, N-2499, N-2549.) 18 pp.

R-3612-AF Dyna-METRIC Version 5: A Capability Assessment Model Including Constrained Repair and Management Adaptations. K. Isaacson, P. M. Boren. August 1988.

Dyna-METRIC Version 5 is a capability assessment model that relates logistics resources and policies to wartime readiness. This report, intended for users of the Version 5 Dyna-METRIC model, describes the model's motivation, capabilities, use, and methodology. Version 5 was developed to more accurately represent the uncertainty in demand and repair, especially queuing and unanticipated demands. It is expressly suited to analysis of the effect of constraints on resources in the context of aircraft components and to evaluation of ways to overcome these constraints. 103 pp. Ref.

R-3660-AF Airpower in Peripheral Conflict: The French Experience in Africa. M. A. Lorell. January 1989.

This report reviews French Air Force (FAF) involvement in military operations outside of Europe since the early 1960s and then more closely examines FAF operations in Chad from 1978 through mid-1987. Part of a larger RAND research effort aimed at enhancing the future effectiveness of U.S. Air Force air power in peripheral conflicts, this study assesses (1) the relative effectiveness of air power in French overseas operations; (2) the constraints placed on the use of air power and how they influenced its effectiveness; and (3) the unique aspects of FAF force structure, equipment, organization, doctrine employment concepts, and training designed specifically for peripheral operations. The author concludes that, in response to growing military capabilities of Third World opponents, air power has become an increasingly critical component of French overseas projection forces. However, French experience confirms that air power can make a decisive contribution in peripheral conflicts only when it is combined with aggressive joint land operations. 79 pp. Bibliog.

R-3664-AF The Soviet Military Leadership and the Question of Soviet Deployment Retreats. H. Gelman. November 1988.

This report examines the effect on Soviet civil-military relations of reducing certain Soviet conventional force deployments around the Soviet periphery. The author discusses the attitude Soviet military leaders are likely to display toward five hypothetical deployment retreats: (1) major asymmetrical Soviet conventional force reductions in Europe, (2) a decision to carry out major unilateral reductions in the forces on the Chinese border, (3) an Afghan withdrawal carried to the point of accepting loss of Soviet control in Kabul, (4) a decision to alter Soviet policy regarding Vietnam and Cambodia to a degree that would jeopardize the Soviet military position at Cam Ranh Bay, and (5) a decision to return to Japan some or all of the Northern Territories. Finally, in each case the author evaluates the degree to which the Gorbachev leadership is likely to see various political and economic considerations as reinforcing or contradicting military arguments. 62 pp.

R-3698-AF Generalizations of Palm's Theorem and Dyna-METRIC's Demand and Pipeline Variability. M. J. Carrillo. January 1989.

Palm's theorem is a useful tool in modeling inventory problems in logistics models such as METRIC and Mod-METRIC. However, to fit its limited domain of applicability, time-dependent customer arrival rates have been approximated by the required constant rates, which results in a possible loss of accuracy. This report reviews the extension of Palm's theorem for time-dependent arrival rates and service distributions under Poisson input, and it provides further extensions to compound Poisson input. The extensions make it possible to model processes in which the number either of demands or of customers in service has variance-to-mean ratios greater than or equal to unity. The report introduces the nonhomogeneous Poisson queue with infinite servers, and develops a generalization of Palm's Theorem to nonhomogeneous Poisson input. The author shows that

comparable results hold for compound Poisson input. He then relates these results to two-echelon repair systems. Finally, he covers various initial conditions of the queueing system. 19 pp. Ref.

NOTES

N-1000-AF The Significance of Divergent U.S.-USSR Military Expenditure. A. J. Alexander, A. S. Becker, W. E. Hoehn, Jr. February 1979.

Due to steady increases in Soviet military expenditure over 15 years, plus sharp decreases in U.S. outlays in the first part of the 1970s, the size of Soviet military programs has exceeded that of U.S. programs for several years. The margin has been widening and is forecast to persist. The disparity in many mission outlay areas is impressively large: a three-to-one advantage to the Soviet Union in Strategic Forces; about 75 percent more than the United States for General Purpose Forces; and near parity with the United States in Support Forces. In military investment the Soviet margin has been 50 to 80 percent above the United States. These disparities constitute an additional indicator that the United States needs military effort. However, the so-called "defense spending gap" cannot indicate the U.S. effort required. The latter depends on the mix of military capabilities necessary to meet peacetime, crisis and long-term competition criteria. 57 pp. Ref.

N-1003-AF Quality-Quantity Tradeoffs: Historical Air Combat Data and the ACEVAL Test (U). C. T. Kelley, Jr. August 1979. Secret.

(U) Compares the effect of aircraft quantity on air-to-air engagement results using data from historical combat and from the recently completed ACEVAL test. The historical data are from World War II, the Korean War, and the Southeast Asian conflict. The ACEVAL data are from the F-15 vs. F-5 engagements. We found that trends of the historical data are reasonably consistent and show a moderate influence of quantity on engagement results. The ACEVAL data show a much stronger influence of quantity similar to that predicted by the Lanchester square law. Comparisons of F-15 and F-5 relative performance in ACEVAL with earlier analytic results suggests that the quality of air-to-air munitions has increased to where the difference in the technical specifications of the aircraft themselves appears to be less important as a determinant of engagement outcome. 29 pp. Bibliog.

N-1013-1-AF A Sequential Analysis of the Air Force Officer's Retirement Decision. G. Gotz, J. J. McCall. October 1979.

A stochastic dynamic programming model that explicitly examines the incentives to retire from the military is developed and numerically evaluated. The dynamic program includes the most significant institutional factors affecting an Air Force officer's retirement decision; actual

data on promotion probabilities, officer's pay and allowances, and retirement pay are embedded in the model. The Note is a progress report; research generalizing the model presented in this Note will be presented in a future report. 80 pp.

N-1021-AF A New Approach to Defense Industrial Planning: Briefing Documentation. G. G. Baumbusch. May 1979.

Documents a briefing on policy implications of recent RAND research on defense industrial surge capability. The briefing suggests that a methodology for assessing defense industrial surge capability should be based on good demand analysis, should provide a methodology for obtaining an overview of the industrial activity necessary for defense production, and should have a mechanism for gathering detailed information from potential problem industries. Such a methodology was tested in RAND research and is suggested as an alternative to the current Department of Defense Industrial Preparedness Planning data collection. 25 pp.

N-1022-AF Gaming a Persian Gulf Contingency. C. H. Builder, W. M. Jones. April 1979.

Description of the gaming of a hypothetical conflict set in the Persian Gulf region. The game was conducted in January 1978, by more than two dozen RAND researchers, to expose military planning and regional security problems. The Note describes the origin, design, and structure of the game; gives a guide to the interpretation of political/military gaming; provides a narrative of the game events as a synthetic history of a conflict; and assesses issues raised by the game. 35 pp.

N-1161-1-AF DOSS as an Analysis Tool: Applications to the B-52 Aircrew Continuation Training Test Program: A Progress Report. R. Fallon. July 1979.

Presents early results towards evaluating a rule-based system, called the Decision Oriented Scheduling System (DOSS), as an analysis tool. DOSS is used to model SAC wing scheduling in order to examine the effects of several alternative policies and procedures on wing performance. This effort has provided estimates regarding the usefulness of DOSS for analyzing alternative scheduling policies, as well as identified possible payoffs in wing performance resulting from alternative policies. 43 pp.

N-1174-AF Space Surveillance Issues: A Briefing on Technology Assessment (U). K. P. Horn. July 1979. Secret.

(U) Reports on the initial phase of the Project AIR FORCE study on Space Surveillance issues. The purpose of the project is to provide a rational basis for forthcoming budgeting decisions that will shape the space-based infrared and radar surveillance capabilities in the 1980s. The Note documents a briefing on a technology assessment of infrared surveillance. It discusses the deficiencies in the current systems and the rationales for the advanced systems. It concludes that survivability is the key issue facing the follow-on systems. 26 pp.

N-1180-1-AF Strategic Warning and General War: A Look at the Conceptual Issues. R. E. Strauch. October 1979.

Explores conceptual issues related to strategic warning of general nuclear war. A "threat/response cycle" is proposed as a conceptual model of warning situations and is used to explore the differences between tactical and strategic warning. Response to strategic warning is discussed, as is the assessment of the utility of strategic warning. 51 pp. Ref.

N-1184-AF The Quality of Air Force Outpatient Care: How Well Do Physician Assistants Perform? G. A. Goldberg, A. F. Siegel, D. S. Chu, D. G. Jolly. June 1979.

Analyzes quality of care rendered by physician assistants (PAs), who work under a doctor's general supervision in Air Force clinics and care for some patients formerly treated by physicians. It focuses on the technical process of care, and uses data collected with a patient contact record at nine Air Force bases in 1974. For a set of conditions that account for 20 to 25 percent of outpatient visits to clinics dealing with general medicine problems, the analysis shows that PAs are performing at least as well as physicians. It is concluded that the Air Force can deliver the same quality of medical care when PAs, working under a doctor's general supervision, treat some of the patients formerly seen by physicians. 45 pp. Ref.

N-1210-AF Soviet Leadership Politics and Leadership Views on the Use of Military Force. W. M. Jones. July 1979.

Soviet military doctrinal writings emphasize the value of preemptive attacks carried through to the complete defeat of the enemy. An examination of histories of various Soviet leaders reveals a recurrent pattern. A dominant leader is replaced by a group of successors which, in turn, devolves into competition ending only when one competitor has established dominance. In the dominant leader phase, and early days of competition phase, aspirants to the top position enhance their power by building a coterie of proteges. Once the competition flares into direct conflict, the ultimate winner has preemptively attacked his opponents and their coterie, and carried through until eliminated as a future threat. Assuming that Soviet leaders would view the prospect of major superpower war as being analogous to top level political power struggle, their history and experience would tend them toward preemption in force with intention of carrying through until the enemy is eliminated as a threat. 24 pp.

N-1214-1-AF Defense Modernization in the People's Republic of China. J. D. Pollack. October 1979.

Briefly reviews the strategies Chinese decisionmakers have used since 1949 to modernize their defense establishment. The study then considers recent efforts to amend previous strategies in military research, development, and production, most notably through possible purchases of advanced foreign military technology. Rapid and extensive purchase of weaponry abroad is not a worthwhile security option for the People's Republic of China (PRC). The available budgetary and manpower resources are insufficient, and

such an approach would not significantly enhance Chinese security over the short run. Thus, any major improvement in the PRC's military capabilities will occur only after a prolonged process of economic development, industrial growth, and sustained technological absorption. An effective U.S. policy framework for technology transfer to the PRC must pay careful heed to the long-term manpower and budgetary constraints that will continue to affect the modernization of China's armed forces. 24 pp.

N-1216-AF Structuring the Components of the Image Matching Problem. J. A. Ratkovic. December 1979.

This Note briefly describes the matching process. The major emphasis is in describing the elements of the matching process—the scene, matching algorithms, and errors—and determining their roles in and effect on the matching process. A means is provided for structuring the map matching problem. The scene is defined by the degree of homogeneity and the number of independent elements in each homogeneous region. The errors are further broken up into categories that are mutually exclusive, comprehensive, and positively related to a preprocessing technique or algorithm required to accommodate them. The errors are thus broken up into one of the following categories: global, regional, local, and nonstructured. Finally, the matching algorithms are defined as being of a feature matching correlation or hybrid type. The latter type is a new class of algorithm developed at RAND which bridges the gap between feature matching and correlation types of algorithms. 27 pp. Bibliog.

N-1217-AF Performance Considerations for Image Matching Systems. J. A. Ratkovic. December 1979.

Describes the underlying factors which affect system performance—accuracy of match and probability of false match—in map matching systems. Methods for improving system accuracy are discussed. A methodology for managing false fix probability during the acquisition phase is developed. Rules for accommodating various types of system problems in terms of preprocessing, scene selection, and algorithm choice are presented. Finally, simulation results are given to verify the discussion. 71 pp.

N-1228-AF Air/Ground Attack Operations in Night and Adverse-Weather Conditions: A Survey of Past Combat Experience (U). C. B. East, E. H. Sharkey. August 1979. Confidential.

(U) The inability of manned aircraft to conduct effective battlefield ground attack in night and adverse-weather conditions has been a source of frustration to military airmen and has deprived the ground forces of much-needed firepower support for approximately half of their fighting day. This Note reviews in brief chronological order the equipment, procedures, tactics and techniques that have been utilized in an attempt to render useful support to friendly forces beginning in World War I and continuing to the present time. It also discusses in detail some of the more useful or noteworthy developments that have been utilized in night and adverse-weather operations, and the systems that currently promise a resolution of some of the associated problems. Technology developed in the last decade promises an effective high-precision night/adverse-weather at-

tack capability that, although costly, will have a major effect on conduct of future tactical nonnuclear wars. 80 pp. Bibliog.

N-1238-AF American Nuclear Strategy: A Selective Analytic Survey of Threat Concepts for Deterrence and Compellence. M. W. Kanzelberger. September 1979.

Surveys analytically selected nuclear strategies proffered in the unclassified literature since World War II. Types and subtypes of strategies are identified and analyzed on the basis of the threat concepts that underpin them and the targeting schemes that back them up. Entries are catalogued according to whether the implied threat promises to punish, deny, or compel adversary actions, roughly in order of the amount of destruction suggested by the accompanying target plan, from greatest to least intended trauma. Each entry is then followed by one or more abstracts of selected works seminal to, or representative of, that particular variant, highlighting assumptions about the relationship of the threat design to U.S. political objectives and tracing the implications carried in the event that the weapons must be used. 58 pp. Ref.

N-1241-AF Air Force Acquisition Options for the 1980s: A Briefing on Study Plans. G. K. Smith. July 1979.

Presents the slides and text of an informal briefing given at HQ AFSC in June 1979. Outlines the current status of RAND project, "Air Force Acquisition Options for the 1980s," puts this project in the context of previous RAND work, and describes study plans. Emphasis is on how to acquire weapon systems, not what systems to acquire. (Not distributed to subscription libraries.) 13 pp.

N-1247-AF Estimating the Time Required To Transition Aircraft Fleets to New Scheduled Maintenance Intervals. I. K. Cohen, E. C. Poggio. October 1979.

Typically, decisionmakers are called upon to make decisions on aircraft inspection intervals on the basis of very limited analytic information. Under such circumstances, decisionmakers are understandably concerned about the risks incurred in extending inspection intervals. This Note presents in some detail a discussion of the phenomenon that although an immediate change is made in inspection intervals, it takes a considerable period of time for the fleet to transition to the changed interval. The slow fleet maturation may provide considerable opportunity to monitor and control the condition of the fleet during the transition period. Thus, in the case of extending inspection intervals, risk is reduced and spread over time while the payoff for the change is immediate. 29 pp.

N-1258-AF The Redundancy of Scheduled and Unscheduled Maintenance. I. K. Cohen, T. S. Donaldson, T. M. Rodriguez. September 1979.

This Note concerns the extent to which aircraft scheduled and unscheduled maintenance are redundant. It investigates the extent to which periodic inspection items on the F-4 aircraft are made visible at the flight line during unscheduled maintenance. The study focuses on inspection tasks behind aircraft doors, and assumes that once a door is removed for

maintenance activity the inspection item is visible. Visibility or accessibility for condition monitoring is defined as the frequency of door removals. The total number of removals for each aircraft door was counted, and a probability model was used to estimate the probability that a door would be opened within a given inspection interval. The results of this study indicate that most of the F-4 periodic inspection tasks are accessible for condition monitoring on the flight line during unscheduled maintenance. The Note discusses the implications of these results for inspection policy. 31 pp.

N-1260-AF A Preliminary Analysis of the Effect of Work-Arounds on Space System Performance and Procurement Requirements—A Proposal. A. G. Parish, W. Sollfrey. March 1980.

This Note identifies a factor that appears to have been neglected in explaining the discrepancy between predicted and observed satellite lifetimes in orbit. This factor—extension of satellite life through ingenious "work-around" corrections—is not represented in current satellite replenishment models. The Note explores the effect of the omission on various measures of system performance, develops an analytical method of incorporating these work-arounds in replenishment models, and derives an initial estimate of the required parameters from a convenient database. Incorporating the effect of work-arounds dramatically improves system performance and lowers procurement requirements. 27 pp. Ref.

N-1265-AF Reflections on Territorial Defense. H. Mendershausen. January 1980.

A territorial defense posture is a system that (1) is defensive, unsuited to attack across borders, and unlikely to be perceived as a threat by other states; (2) relies principally on latent rather than standing forces, involving many citizens; (3) relies on weapons and technologies different in type and composition from those of intervention and bombardment systems; and (4) relates the military resources of a society so closely to the defense of its own territory and institutions that it constrains the country's participation in an international military alliance, especially one that calls for an integration of alliance forces. A territorial defense doctrine goes with a military function or type of force that plays a greater or smaller role in a country's total military establishment, besides other functions or force types that have doctrines of their own. Aside from international political and strategic conditions, domestic political factors may increase or reduce the prominence given to territorial forces in a country's military system. 22 pp.

N-1269-AF Escalation Space and Assumptions About Enemy Motivations: Elements in Warning Assessments. W. M. Jones. January 1980.

Strategic warning may be viewed as contingently predicting an imminent, significant escalation of a confrontation. Warning of an imminent Soviet strategic nuclear attack is one of a large set of possible escalations, although of unique consequence. Confrontations and conflicts may be characterized as a series of escalations and de-escalations by one or both sides, involving some six factors that cover the par-

ticipants, the locale, the degree of superpower involvements, the superpower declaratory policies, the types of weapons in use, and the targets of the military violence. By locating these variables on each of these ladders at every juncture in a confrontation, the warning analyst can identify the various steps open to the enemy. To assist him in deciding which possibilities warrant his close attention, he must make some basic assumptions about enemy decisionmaking determinants. The making of such assumptions is inevitable; they should be explicit. 29 pp.

N-1273-AF Perception and Strategic Warning. E. D. Brunner. November 1979.

Strategic warning is described as a perception occurring to persons in the nation's top leadership that an opponent may launch a nuclear attack. Because the only opponent now likely to take this action is the USSR, an examination is made of reasons that might impel it to do so. A survey is made of preparatory events in the USSR that would be related to the way in which war might begin. The chain between events observable by our intelligence apparatus and response by U.S. leadership is traced. The processes of evaluation of evidence and leadership decisionmaking are examined and illustrated with historical cases from World War I into the 1970s. Factors influencing this process include the power of fixed ideas, informational failures, deception, value systems of the protagonists, and the dangers inherent in the dynamics of group decisionmaking. An example of successful perception of strategic warning and response (Cuba, 1962) is discussed. 35 pp. Bibliog.

N-1285-AF Space Surveillance Issues: A Briefing on Mission Assessment (U). K. P. Horn. November 1979. Secret.

(U) Reproduction of the charts and text of a briefing whose purpose is to assess possible missions of an infrared space surveillance system that would follow the system now in use. The briefing concentrates on early warning and attack characterization missions. The current system is assessed and recommendations for further study are made. 25 pp.

N-1295-AF Cost Effectiveness Measures of Replenishment Strategies for Systems of Orbital Spacecraft. B. E. Krell. December 1979.

In recent years, the U.S. Air Force has made extensive use of large scale simulation models to evaluate satellite and booster procurement strategies. This study describes the differences and similarities of the three most common simulation programs employed and establishes a simpler, closed form approximation which may be implemented on a desktop calculator. The final sections present comparisons between the simulation results and the analytical approximations using specific test cases cited in the documentation of the simulation models described. Finally, an explanation is provided regarding the relationship between the simulation models and the closed form solutions. 51 pp. Ref.

N-1303-AF Patient Acceptance of the Air Force Physician Assistant. D. J. Armor. November 1979.

An investigation of patient acceptance of physician assistants (PAs) and nurse practitioners (NPs). Shortfalls in physician manning have led the Air Force to experiment with physician extenders such as PAs and NPs. These new health professionals extend physician manpower by performing a wide variety of diagnostic and treatment services under the supervision of a physician. Based on an analysis of both usage rates and attitudes, the study finds wide patient acceptance of these extender programs and high ratings of the quality of care by extenders. On the other hand, a small minority of patients, about one-sixth or one-fifth, are opposed to PAs and NPs even after some contact with them. The opposition appears to be confined to specific functions of the extender, such as physical exams or treating more serious internal problems. It is concluded that substitution of PA and NP services for certain traditional physician services should be successful from the standpoint of patient acceptance. 43 pp. Ref.

N-1311-AF Aircraft Icing During Low-Level Flights. R. R. Rapp. November 1979.

The reasons why ice formation may hinder low and slow flights are presented. A crude measure of the potential of icing near the ground is presented and it is shown that, by this measure, icing may be a serious problem for flights over the higher terrain of central Europe. Some suggestions for improving the measure of icing potential are given. 11 pp. Ref.

N-1323-AF Soviet Options for Discriminating and Selective Nuclear Attacks in Europe: A Briefing (U). J. W. Ellis, Jr., F. Kozaczka. December 1979. Secret Formerly Restricted Data Intelligence Information.

(U) Examines the extent and implications of collateral civilian casualties attending a Soviet preemptive nuclear attack on NATO military targets in an unalerted, peacetime state. The analysis considers several feasible Soviet attack options with varying weapon yield and delivery accuracy, height of burst (air or surface), and number and type of targets attacked. A Monte Carlo damage assessment technique computes both the level and the uncertainty of target damage and of civilian casualties. Examination of the results confirms that the Soviets have the capability to devastate Western Europe. However, should they choose, the Soviets could control collateral civilian casualties by using only air-burst weapons of moderate yield and by exercising prudent target selection. Consequently, NATO planners should consider the possibility that the Soviets might believe the military advantages of a preemptive nuclear attack could outweigh the risks. 32 pp. Ref.

N-1326-1-AF Cooperative Air Defense Systems: Interim Briefing. R. E. Horvath, W. P. Hutzler, R. Y. Pei, B. F. Powers. January 1980. Not Reviewed for Public Release.

With currently deployed equipment, is it possible for aircraft tracks developed by the radar and computer aboard the E-3A AWACS aircraft to be passed to Army surface-to-air missile sites? This Note says it is possible, and raises some of the questions associated with whether it should be done. 30 pp.

N-1327-AF Patterns of Organizational Influence in Soviet Military Procurement. A. J. Alexander. April 1982.

Although political choices have established the thrust of present Soviet weapons procurement policies, these choices and their implementation are conditioned by decisionmaking procedures and organizational relationships. The military maintains a near-monopoly of information and expertise on military affairs. This monopoly, coupled with a generation of alternative policies in military and civilian sectors that is conservative and incremental, requires that nonincremental change be stimulated by intervention from the political leaders. But, in order to preserve its stability, the collective leadership of the past 15 years is also conservative and incremental. We can therefore expect continuation of present trends until major change is broadly supported by the leadership. 13 pp.

N-1336-AF Soviet Perspectives on Target Selection, and the Target Menu Implied: Part I, Survey and Description (U). N. Hanunian. April 1980. Secret NOFORN WNIINTEL.

(U) A description of Soviet targeting intentions and aspirations is developed, documented by quotations from the USSR's military theoreticians; and this is then used to guide the construction of a master target list—one from which realistic Soviet offensive strikes can readily be drawn. Source material for the quotations included numerous articles in the Soviet journal, *Military Thought*, as well as books by prominent Soviet military officers. Items on the target list were excerpted from a variety of sources, but preponderantly from a classified target compendium (the Joint Resource Assessment Data Base). 50 pp. Ref.

N-1337-AF An Approach to the Life-Cycle Analysis of Aircraft Turbine Engines. J. R. Nelson. November 1979.

A paper prepared for the AGARD/NATO Lecture Series, "The Application of Design to Cost and Life-Cycle Cost to Aircraft Engines," scheduled for May 1980. A methodology is described for life-cycle analysis of aircraft turbine engines from historical data. The methodology enables the weapon-system planner to acquire early visibility of cost magnitudes, proportions, and trends associated with a new military engine's life cycle, and to identify "drivers" that increase cost and can lower capability. The methodology is applied at the engine subsystem and aircraft system levels for a military fighter aircraft to demonstrate that decisions about engine performance/schedule/cost must be made at the system level. Commercial considerations are discussed, as is limited historical experience in engine monitoring, an approach to obtaining the necessary information, and procedures for performance and cost feedback to the engine designer. This Note presents portions of previously published RAND work on life-cycle analysis of aircraft turbine engines and engine monitoring systems, together with some recent unpublished work applying the earlier efforts at the aircraft system level. 49 pp. Ref.

N-1342-AF Potential Civilian Earnings of Military Physician's Assistants. S. Hosek. February 1980.

Discusses the adequacy of military physician assistants' (PAs) pay under two grade options: warrant officer and commissioned officer. Military career pay profiles are compared with estimated civilian experience-earnings profiles. These estimated civilian earnings profiles are estimated from 1978 earnings data collected by the Association of Physician Assistant Programs. Because military PAs are relatively well qualified, the earnings estimates are based on a sample of comparably qualified civilian PAs. Comparisons of military and potential civilian earnings profiles under the two grade options, assuming varying amounts of pre-PA military service, fail to provide conclusive support for either commissioning or warrant officer status. However, the comparisons do suggest that, if the other military services wish to follow the Air Force's lead and intensively employ PAs, commissioning may be needed to guarantee an adequate supply of qualified PAs. 29 pp.

N-1450-AF A Computer Aided Exercise Facility for Tactical Air Command and Control Evaluation: Concepts and Design Overview. M. Callero, R. E. Strauch, J. R. Lind. April 1980.

The evaluation of tactical air command and control systems and processes is a difficult and demanding task for which current tools are seriously flawed. This Note suggests a new tool for that purpose, a Computer Aided Exercise Facility combining characteristics of computer modeling and of existing military exercises in a way which allows the strengths of each to balance out the weaknesses of the other. The rationale for development of such a facility is discussed and a preliminary conceptual design proposed. 69 pp. Ref.

N-1459-AF A Heretical View of Space Systems Survivability (U). J. J. Mate, Jr. February 1980. Secret.

(U) This Note analyzes why the United States is making slow progress in (1) exploiting space systems for war-fighting purposes, and (2) implementing space systems survivability improvements. Both are inexorably intertwined. Current and potential space systems users are reluctant and wary of exploiting and depending on space systems for many reasons, a key one being legitimate concerns for survivability. But survivability implementation is inhibited by a lack of firm and/or tentative future operational requirements from users. This analysis suggests a new survivability strategy called "Planning, Vigilance, and Response," identifies pure survivability options and adjuncts, space fleet architectural approaches, and survivability technology areas to be pursued. The overall objective is to stimulate the defense community with new, often heretical, notions for future progress in space systems survivability. 25 pp. Ref.

N-1460-AF TSARINA: User's Guide to a Computer Model for Damage Assessment of Complex Airbase Targets. D. E. Emerson. July 1980.

Description of the TSARINA computer program, developed to examine conventional air attacks against complex targets and to assess losses and damage to categories of resources and to buildings and other facilities. TSARINA permits damage assessments of attacks on an airbase complex composed of up to 500 individual targets (buildings, taxiways,

etc.) and 1,000 packets of resources. Targets may be grouped into 20 vulnerability categories, and different types of personnel, equipment, munitions, spare parts, and other support resources can be distinguished. TSARINA determines the actual impact points by Monte Carlo procedures and the losses and damage are assessed using "cookie-cutter" weapon-effects approximations. TSARINA may be employed separately as a general-purpose model or used in conjunction with the TSAR (Theater Simulation of Airbase Resources) computer model to assess the impact of airbase damage on sortie generation capabilities and to evaluate proposals for improving those capabilities at an airbase or set of airbases. Detailed user instructions and a listing of the program are included. 123 pp.

N-1462-AF Estimates of USAF Personnel Casualties and WRM Losses: A Study of USAFE and Korean Airbases (U). D. E. Emerson, F. Kozaczka, J. H. Rosen. February 1980. Secret NOFORN WNINTEL.

(U) Summarizes an analysis of the personnel and war reserve materiel losses that could be inflicted by conventional enemy air attacks against Air Force bases in Europe and South Korea in the early 1980s. The analysis explores losses that might be expected at five bases in Central Europe and at three bases in South Korea, and investigates the sensitivity of such projections to enemy attack options. The approach used was to conduct computer simulations of several different attacks at each airbase using a computer model that permits detailed representation of various facilities and resources. The study was initiated in response to an Air Force request for assistance in developing planning factors needed in determining wartime requirements. 117 pp. Ref.

N-1464-1-AF Application of a New Low-Sidelobe Antenna in Earth-Satellite Communications Links (U). S. Katz, N. E. Feldman. March 1981. Secret.

(U) Using unclassified experimental data on recent developments in low-sidelobe antenna technology, the authors briefly examined two potential applications: very-low-sidelobe antennas on communications satellites and on earth stations. 36 pp. Ref.

N-1476-AF Air Force Manpower, Personnel, and Training System: Vol. II, Analysis of the Enlisted Authorization/Assignment and Manpower Requirements/Personnel Objectives Subsystems. B. E. Armstrong, S. W. Chapel, S. C. Moore. May 1980.

Describes evaluation of two subsystems for enlisted force management: a short-term or "programming" subsystem and a long-term or "planning" subsystem. The short-term subsystem is evaluated by comparing personnel assignments in about two hundred occupational specialties over a three-and-one-half-year period. The statistical methods employed should be useful in developing more detailed comparisons within occupations (i.e., authorization-assignment agreement according to skill level, pay grade, command, etc.). The long-term subsystem is evaluated by reviewing its logical and operational structure. While its many strengths are apparent, the subsystem is somewhat lacking in integration, largely because it lacks effective focus on

cost and productivity characteristics associated with different types of people (e.g., experienced vs. inexperienced people within different occupations). We recommend that practical mechanisms be developed which will permit (1) identification of multiple manpower/personnel force structures (within occupations and forcewide) capable of meeting mission requirements and (2) evaluation of and selection among these alternatives. 118 pp. Ref.

N-1478-AF Recent RAND Reports Containing Military Weather Analyses: An Annotated Bibliography. R. E. Huschke. May 1980.

A chronological and annotated listing of 23 RAND reports published since 1970 that deal with the effects of weather and the atmosphere on military systems and operations. The Note complements R-2401, which contains a collection of 14 weather analyses. 7 pp.

N-1481-AF Special Duty and Combat Aircraft Avionics Data Base (U). J. A. Dryden, T. P. Britt, Jr., S. A. Binnings-DePriester. September 1980. Secret Privileged Information.

(U) Presents the cost, physical, and performance characteristics of avionics installed on 5 special-duty (e.g., E-3A) and 17 combat (fighter and attack) aircraft. Provides avionics data for all aircraft at the system (unique units such as the APG-63 radar) and the suite (all avionics aboard a particular aircraft) levels. Organizes the 223 systems associated with combat aircraft into 13 functional groups (e.g., computers) and gives descriptions, detail and summary statistics, correlation matrices, aircraft usages, and manufacturers for each group and for all systems. Supplies a data sheet for each combat system that furnishes (where available) cost, production, technical, descriptive, application and manufacturers information. The database is neither complete nor always in a form appropriate for analysis. It is, however, the best currently available to RAND and should prove useful for analogous estimating of avionics systems and suites. 488 pp. Bibliog.

N-1482-AF Models and Techniques for Recoverable Item Stockage When Demand and the Repair Process are Nonstationary—Part I: Performance Measurement. R. J. Hillestad, M. J. Carrillo. May 1980.

Provides an integrated approach to inventory performance measurement for a given stockage allocation for systems with nonstationary demands and service rates. Suggests approaches to certain aspects of recoverable item repair and supply that currently cause significant deviation between practice and theory, even in the case of stationary demands and service rates. Provides models for different degrees of cannibalization of primary recoverable items. Describes a group of scenario-dependent performance measures for predicting the effects of inventory and service policy on organizational performance. Reader will require a knowledge of probability theory. 36 pp. Ref.

N-1485-AF Soviet Space Systems Support to Strategic Conflicts (U). J. J. Mate, Jr., C. J. Myers, Jr. December 1980. Secret Restricted Data NOFORN WNINTEL.

(U) Analyses of possible Soviet space systems uses in strategic nuclear conflicts. 92 pp. Ref.

N-1489-AF Rule-Based Modeling as an Analysis Tool: Implications for Resource Allocation Within the Strategic Air Command. R. Fallon. April 1980.

Examines the potential of rule-based modeling as an analysis tool for investigating resource allocation policy issues. Focus is on resource allocation within B-52 flying organizations of the Strategic Air Command (SAC). A rule-based computer system, DOSS (Decision Oriented Scheduling System), is demonstrated to provide a valid model of many variables that affect resource allocation of aircrews and aircraft. DOSS is then used to analyze effects on wing performance of several alternative decision rules and policies. Analysis focuses on the capability of SAC bomb wings, given current resources, to increase the SAC alert force and to fly more training sorties. The analysis has implications for the particular policy issues examined, but its more general aim is to illustrate the potential of DOSS for examining a broad range of resource allocation policy issues within SAC. A number of implications are discussed regarding the potential of rule-based modeling for improving organizational decisionmaking in general. 171 pp. Bibliog.

N-1490-AF Problems of Risk, Uncertainty, and the Conduct of Nuclear War in Soviet Military Thought (U). R. E. Gottemoeller. June 1980. Confidential NOFORN WNINTEL.

(U) Examines, on the basis of Soviet literature, what Soviet military writers consider to be the problems of nuclear war, placing these problems in the context of Soviet risk theory. The study focuses on the continued debate among Soviet analysts grappling with modern warfare's many unknowns. It concludes with consideration of the effect that such unknowns may have on Soviet risktaking in nuclear war. 60 pp.

N-1495-AF A Model of Vehicle Activity in the Warsaw Pact Tactical Rear During a Conventional Attack Against NATO. R. A. Wise, R. L. Blachly, T. T. Connors, C. B. East, J. R. Hiland, D. E. Lewis, G. F. Mills. September 1980.

A synthetic history of vehicular activity in the rear area of a Soviet tank army during a five-day offensive against U.S. V Corps is developed and described. The history consists of detailed records of 2,088 movement events involving 11,266 vehicles. Vehicles are identified in terms of 15 types. The record of each event includes the location of its origin and destination with respect to the FEBA, its departure and arrival times, its composition by numbers and types of vehicles and the kind of unit involved in the move. Various statistical representations of the history are presented. Conversion of the history to a computer model of vehicular activity is described. 106 pp. Ref.

N-1496-AF Exploitability of the Warsaw Pact Tactical Rear: Methodology, Input Data and Results (U). C. B. East, G. F. Mills, R. L. Blachly, T. T. Connors, J. R. Hiland,

D. E. Lewis, R. A. Wise. September 1980. Secret NOFORN WNINTEL.

(U) Examines how attacks against the Warsaw Pact tactical rear area (located between 15 and 75 km behind an attacking ground force) can degrade the attacker's combat potential, and whether current (1980) NATO tactical air forces are capable of conducting such attacks. Identifies the critical targets in the tactical rear, and the conditions necessary for these targets to exist. Develops a simple ground combat model, and uses it to estimate the amounts of rear-area disruption required to delay the Pact advance for different lengths of time, using various attack strategies both with and without Pact responses to rear-area attacks. Compares the required attacks and the capabilities of NATO's 1980 tactical air forces. Indicates the best tactic for the current force and recommends an additional direction for current development efforts. 91 pp. Ref.

N-1497-AF Exploitability of the Warsaw Pact Tactical Rear: Lines-of-Communication Analysis (U). T. T. Connors, J. R. Hiland, R. L. Blachly, C. B. East, D. E. Lewis, G. F. Mills, R. A. Wise. August 1980. Secret Intelligence Information.

(U) Examines one method for closing choke points on the Warsaw Pact's tactical rear lines of communication (LOCs) such that critical support functions for an attacking first echelon division are disrupted and delayed. Using the geography of West Germany's Fulda Gap and a hypothetical Warsaw Pact attack, an analysis is made of LOCs and choke points, the number of choke point closures required to inhibit the movement of critical support traffic, and the capability of Soviet combat engineers to make closure repairs. The Note concludes that the continuous nighttime closure of LOC choke points can not only delay the arrival of needed support at the front but may also create potential daylight targets for tactical air exploitation. It recommends that the Air Force give more attention to the potential benefits of a timely and selective attack on LOC choke points. 98 pp. Ref.

N-1508-2-AF The SNAPPER Nuclear Damage Assessment Model (U). B. W. Bennett. June 1980. Secret Formerly Restricted Data.

(U) SNAPPER is a general nuclear damage assessment model, with the special virtues that it adds a capability to evaluate economically the outcomes of limited attacks, and also provides a means for evaluating the uncertainties associated with attacks of any size. This Note describes how SNAPPER operates. It presents many examples of how to prepare inputs for the model, and the types of results that SNAPPER will generate based on these inputs. It also shows how the various parts of the computer program operate, including enough information to provide a general understanding of the model and its algorithms. In particular, this Note demonstrates the tremendous flexibility of the SNAPPER program, as well as its usability even for analysts who are largely untrained in the use of computers. Thus, this Note serves both as a user's manual and a functional description of SNAPPER. 254 pp. Ref.

N-1515-AF Soviet Military Decisionmaking: A Framework for Analysis. R. E. Porter. June 1980.

This Note explores Soviet decisionmaking on behalf of those with a special interest in the long-term directions of Soviet military policy. Consequently, it approaches the topic from a different perspective and introduces a methodology derived from an analysis of cognitive processes. Using this methodology, it then identifies a structured decision-making process based on some novel insights about Soviet decisionmaking and the special political-military relationship that accompanies it. 39 pp. Bibliog.

N-1516-1-AF The SNAPPER Exchange Model (SNAPPER-EMFASIS) (U). B. W. Bennett. May 1981. Secret Formerly Restricted Data.

(U) SNAPPER-EMFASIS is an exchange model variant of the SNAPPER nuclear damage assessment model. It is designed to evaluate countersilo and similar exchanges involving point target systems, and explicitly considers uncertainties important in strategic force analyses. SNAPPER-EMFASIS provides a mechanism for weapon allocation well beyond that used in SNAPPER, which is made possible by the relative simplicity of allocating weapons against point targets. Although SNAPPER-EMFASIS cannot be used directly to evaluate damage to targets such as population and industry (which SNAPPER does very well by considering target collocation and fallout damage), it is easier to use in evaluating damage against isolated, small targets (such as many military installations). This Note is a user's guide to SNAPPER-EMFASIS. It describes how to use the model, and how data should be entered. It also demonstrates types of results that can be expected and how to interpret those results. (See also N-1508-1.) 69 pp.

N-1524-AF The Soviet Union and Iraq Since 1968. Y. F. Fukuyama. July 1980.

The Soviet Union and Ba'thist Iraq have maintained a close political relationship since 1968 on the basis of their shared anti-imperialism. Soviet arms transfers and political and economic support have enabled Iraq to remain independent of and often hostile to the West. Otherwise, Ba'thist Arab nationalism and Soviet Marxism-Leninism diverge. From 1968 to 1972 Soviet-Iraqi relations were cordial but disputes emerged over the Kurds and the Arab-Israeli dispute. They were closest between 1972 and 1975, when Iraq's conflicts with Iran, the Kurds, Israel, and Western oil companies drove it to heightened dependence on Soviet arms transfers. In the third phase from 1975 to the present (1980), relations have deteriorated because of a reversal of the earlier dependencies. Iraqi oil wealth, the role that France has played as an alternative arms supplier, and increasingly sharp ideological disputes suggest that Iraq's present alienation from the Soviet Union may persist into the future. 81 pp.

N-1528-AF Measuring the Impact of Launch Operations upon Satellite Effectiveness. B. E. Krell. June 1980.

Procurement decisions regarding Department of Defense satellite systems are usually based upon the assumption of a reliable and dependable launch system. Attempts to relate

disruptions of launch operations to numbers of satellites on-orbit are often in the form of discrete-event simulations (requiring many data inputs and large amounts of computer time). The approach which is adopted in this study is a form of continuous simulation (as opposed to discrete-event simulation), an approach which has traditionally been limited to analysis of systems in the physical sciences. The continuous simulation methodology requires significantly fewer inputs than discrete-event simulations and is amenable to implementation on a programmable, hand-held calculator, saving expensive computer and data-gathering time. Several examples are provided which demonstrate how continuous simulation may be used to model disruptions in launch capability and various satellite operational philosophies. 61 pp. Ref.

N-1530-AF Faster-than-Light Particles: A Review of Tachyon Characteristics. E. A. Puscher. October 1980.

Documents an analytical prediction of some of the characteristics which presently undiscovered faster-than-light subatomic particles (called tachyons) must possess if they are to exist without violating the Theory of Special Relativity. A brief review of necessary concepts from the Special Theory is included so that the reader might more readily understand the reasoning as it is developed. Necessary, but not all, characteristics of tachyons are then identified and presented. Finally, an interesting potential relationship between tachyons and antigravity is discussed. 37 pp. Ref.

N-1536-AF Transmission and Orbital Constraints in Space-Related Programs: Project Description. A. L. Hiebert, A. F. Brewer. August 1980.

Future growth in commercial and military space systems is constrained by technical problems associated with the frequency spectrum, by orbital congestion, and by costs stemming from proliferated terminals. The authors outline an Air Force-sponsored research project to design and develop a capability for predicting and analyzing the spectrum/orbital geometry requirements of current and projected U.S. and international space-related systems. The two essential components of the project are a comprehensive space environment database and a computer analysis program. In combination, they will provide a resource for evaluating engineering and architectural designs, identifying and analyzing the impact of intentional and unintentional electromagnetic interference, and predicting probable saturation conditions in spectrum usage and satellite/orbital positions. The project will include assessments of ways to accommodate anticipated growth. It will be structured for a continuing analysis program, which will be accessible to the space community as operational capabilities are acquired. 38 pp. Ref.

N-1560-AF Cruise Missile Penetration Management (U). W. W. Matyskiela. October 1980. Secret.

(U) Charts and text of a briefing estimating the payoff from real-time management of U.S. cruise missiles penetrating enemy air defenses. The management system uses advanced technologies assumed to be available in the late 1980s—millimeter wave communications, survivable communications satellites, and advanced airborne data process-

ing. As radar warning receivers on cruise missiles identify SAM locations, the management system can alert other cruise missiles to avoid these areas. Multiple assignment of cruise missiles with a report-back capability to terminal defense SAMs can minimize the weapons required per target. Continuous force status information allows optimal reassignment of surviving cruise missiles to surviving highest valued targets. The outcome of a simulated cruise missile attack with and without real-time management argues for further research on this subject. 29 pp. Ref.

N-1587-AF An Analysis of Proximity-Detection and Other Algorithms in the ROSS Simulator. W. S. Faught, P. Klahr. March 1981.

Summarizes the mechanisms by which the ROSS simulator computes interactions (collisions and proximities) between objects. ROSS simulates an air penetration scenario and is being developed to research techniques for improving large-scale simulation. The basic algorithm is analyzed in detail to determine its feasibility in the context of large numbers of objects, and to determine where improvements in speed can occur. 39 pp.

N-1599-AF Alternative Launch Systems for Department of Defense Payloads (U). L. N. Rowell, D. J. Dreyfuss. February 1981. Secret.

(U) The Shuttle/Orbiter will be our primary launch system once it becomes operational. Critical Department of Defense (DOD) payloads as well as NASA payloads are scheduled for launch using this system. This Note discusses the types, numbers and costs of alternative launch systems that could be used to place certain critical DOD payloads in orbit in the event that the Shuttle/Orbiter might become unavailable after it becomes operational or have less than anticipated payload capability and frequency of launch. Also discussed are the decisions that must be made now, concerning procurement and development, to ensure that there are adequate back-up launch systems for the Shuttle/Orbiter and unmanned alternative launch systems that could deploy much larger payloads. 45 pp. Ref.

N-1600-AF Projecting the Future for Situation Assessment and Planning: A Cognitive Analysis. B. Hayes-Roth. November 1980.

Situation assessment and planning rely heavily on the decisionmaker's ability to project future conditions in the environment and the impact of tentative planned actions on those conditions. This Note presents a cognitive analysis of the future projection process. It identifies three projection strategies—retrieval from experience, formal analysis, and mental simulation—and characterizes their strengths and weaknesses. It also discusses the impact of three general cognitive factors—operation at different levels of abstraction, motivational factors, and attribution problems—on the future projection process. Based on this analysis, the Note proposes a cognitive technology for developing and training effective future projection processes. 38 pp. Ref.

N-1603-AF Estimating Avionics Software Development Cost. K. E. Marks. March 1981.

Formulates an approach to estimating development cost that is sensitive to the unique characteristics of avionics software functions and provides partial quantitative results for navigation and electronic warfare software. The estimating concept has two basic parts: relating software size to functional characteristics, and quantifying the relationship between cost and size. The influence of functional characteristics on size is demonstrated using data on six military aircraft. EF-111A electronic warfare software cost data provide a preliminary version of a cost-size relationship. The database contains only a few weapon systems, and complete cost information is not available for each system. Future aircraft acquisition programs should require the inclusion of detailed software cost information in the contractually required cost reports, permitting data to be collected for future systems. 56 pp. Ref.

N-1607-AF Direct and Indirect Threats to the Space Transportation System (U). A. Gandara, D. Leinweber. August 1981. Secret Restricted Data NOFORN WNIN-TEL.

(U) A survey of threats to the space transportation system under various levels of conflict, with emphasis on peacetime and limited conflict periods. Threats are categorized as direct and indirect: direct threats include ground attack, ASAT attack, and sabotage of space or ground facilities; indirect threats result from uncertain reliability, unknown vehicle lifetimes and turnaround times, natural disasters such as collision with meteoroids, economic pressures, and insurability problems and policies. The net effect of the risks surrounding the space shuttle is that the continued survivability of the system throughout its planned lifetime cannot be assured or assumed. 91 pp.

N-1615-AF Arms Production in Developing Countries: The Continuing Proliferation of Conventional Weapons. A. L. Ross. October 1981.

The subject of this Note concerns the efforts of developing countries to reduce their dependence on the advanced industrial states, including the development of domestic arms industries. Data are presented on arms production by country for three points in time (1960, 1970, 1980) on four types (and subtypes) of weapons (aircraft, armored vehicles, missiles, and naval vessels). The major increase in weapons production came during the 1970s—15 developing countries produced arms in 1960, 18 in 1970, and 28 in 1980. Non-economic motivations to produce weapons are hypothesized to include external and internal security threats, vulnerability to manipulation by exporters, insecure military security relationships, and national pride, economic goals, import substitution, export potential, and technological stimulation of other sectors. 32 pp.

N-1629-AF Shooting at Satellites in Geosynchronous Orbit and Beyond (U). F. S. Nyland. April 1981. Secret NOFORN Intelligence Information.

(U) Discusses future Soviet options for conducting attacks on high altitude satellites. Interceptor performance, delivery errors, tracking, and warheads are examined. 30 pp. Ref.

N-1633-AF Combat Operations Decisionmaking in Tactical Air Command and Control. R. S. Gaines, W. E. Naslund, R. E. Strauch. December 1980.

Examines the Combat Operations function in tactical air command and control, and explores some of the human and organizational issues related to the use of technology (particularly automation) to support and enhance that function. Command and control of tactical air power involves a combination of people and technology, principally communications and data processing technology. In this Note, "people" issues and the relationships between the human organizations which comprise the command and control system and the technical systems which support them are examined. The authors focus on the command and control process occurring in the Combat Operations section of a Tactical Air Control Center (TACC). This includes monitoring and managing planned air operations as they occur, and modifying those operations to adjust to changing circumstances. TACC can be thought of as a decisionmaking entity in which incoming information about the state of an ongoing conflict is used to manage the employment of airpower resources. 50 pp.

N-1660-AF Applicability of a Low Performance Aircraft Surveillance Satellite (U). D. S. Rubenson. April 1981. Secret NOFORN Intelligence Information.

(U) Charts and text of a briefing on one part of the RAND study on Space Surveillance Issues. Performance requirements for a space-based surveillance satellite are analyzed in an attempt to determine the minimum needed to accomplish useful missions. The applicability of a low-cost near-term surveillance satellite with relaxed performance requirements is evaluated and found to have a specified mission utility. The evolutionary approach employed varies from advanced system concepts that emphasize an all or nothing strategy. 35 pp.

N-1671/1-AF Subjective Measurement of Tactical Air Command and Control: Vol. I, Background and Approach. M. Callero, W. E. Naslund, C. T. Veit. March 1981.

The authors have developed a subjective measurement method for evaluating complex systems and are applying it to the evaluation of tactical air command and control. This Note addresses the major issues of command and control evaluation and describes the newly formulated Subjective Transfer Function (STF) approach and how it will be applied to a specific problem concerning the value of information in effective employment of tactical air. The STF approach stresses the idea of hypothesis testing so that conclusions about system effects on important outcomes are based on tested and verified premises. The approach has application to evaluation of complex systems in general. Other volumes in the series will describe the conduct and results of the command and control evaluation. 42 pp. Ref.

N-1671/2-AF Subjective Measurement of Tactical Air Command and Control: Vol. II, The Initial Representation. M. Callero, W. E. Naslund, C. T. Veit. March 1981.

The authors have developed the Subjective Transfer Function (STF) approach for evaluating complex systems and are applying it to the evaluation of tactical air command and control. The first step in applying the STF approach is to formulate an initial hierarchical representation of the problem domain. This representation reflects initial hypotheses about what are the important components of the domain and how they are interrelated. It provides the framework for testing these hypotheses by measuring professional judgments. This Note displays the initial representation formulated for the command and control evaluation being conducted. Other volumes in this series will describe the conduct and results of the evaluation. 37 pp. Ref.

N-1671/3-AF Subjective Measurement of Tactical Air Command and Control: Vol. III, Preliminary Investigation of Enemy Information Components. C. T. Veit, B. J. Rose, M. Callero. March 1981.

In three experiments, Air Force professionals judged questionnaire items that described characteristics of enemy information against a Korean-like land battle scenario. In two experiments, judgments were of the value of the enemy information characteristics for knowing the enemy's capabilities to conduct ground operations against friendly forces. Results indicated that Precision, Amount, and Currency were the appropriate enemy information characteristics to include in the representation, and a range model was the appropriate subjective transfer function to explain the observed divergent interactions among the characteristics. In the third experiment, respondents judged the Currency of the enemy information given the Frequency with which enemy second echelon forces were observed and the Time to get that information to the command and control systems. The third experiment demonstrated how a representation can be extended to include characteristics (Frequency and Time) that might be easier for the decisionmaker to alter, by employing an existing characteristic (Currency) as a dependent variable. 50 pp. Ref.

N-1685-AF An Analysis of Combat Aircraft Avionics Production Costs. J. A. Dryden, T. P. Britt, Jr., S. A. Binnings-DePriester. March 1981.

Describes research directed toward developing parametric estimating relationships for the production costs of avionics suites and systems. The research sample comprised 17 combat aircraft and their avionics equipment. Potential explanatory variables were selected based on interviews with manufacturers about factors affecting avionics costs and the appropriateness of the variables for use in planning studies early in system acquisition. Multivariate regression analysis techniques were used to determine the statistical properties of candidate estimating relationships for whole suites and individual systems. The estimating equations derived for suite were generally satisfactory but not always as statistically efficient as desirable. Attempts to derive estimating relationships for avionics systems were much less satisfactory but offer improvements over the simple cost-per-pound metrics often used. The authors conclude that

objective means for expressing technology change and its importance for avionics cost estimation remain a concern for future research. 140 pp. Bibliog.

N-1696-AF/ARPA TRIM System Deployment (U). L. N. Rowell. September 1981. Secret. 25 pp. Ref.

N-1761-1-AF Shuttle Fleet Operations: A Simulation Analysis. D. Leinweber. October 1984.

This Note documents a two-part analysis of the reliability of the Space Transportation System (STS). The first part is a statistical examination of the inherent bounds on reliability prediction based on accumulated mission experience as the shuttle program evolves. The results of this analysis suggest that it will take a long history of successes to firmly establish a high shuttle reliability, and that, therefore, some contingency provisions should be retained during the early part of the program at least. The second phase of the analysis is aimed at gaining some insight into operational consequences of less than perfect reliability. This analysis suggests that the risks from the uncertainties surrounding loss or retirement of orbiters, stand-down periods, and delays in refurbishment and turnaround can be reduced by supplementing the four-orbiter STS fleet with alternative launch systems and/or additional orbiters to minimize potential loss of access to space. 55 pp. Ref.

N-1767-AF Observations on Weather Information in Tactical Air Tasking (U). R. E. Huschke, R. R. Rapp, W. E. Naslund. March 1982. Confidential.

(U) This Note introduces the examination of the use of weather information in the tactical air planning cycle. The immediate objective of this work is to describe the air tasking environment and key decision points in the daily tasking cycle at which weather information could have a positive impact on decisions. The authors describe the air tasking decision chain and the opportunities for exploiting weather information. They attempt to bring the air tasking and weather service communities a little closer together by examining the decision points and the options available, and suggesting how weather information is or could be used to improve decisions to make air forces more effective in ground attack missions. 27 pp.

N-1794-AF Preplanned Product Improvement and Other Modification Strategies: Lessons from Past Aircraft Modification Programs. F. P. Biery, M. A. Lorell. December 1981.

Pre-Planned Product Improvement (P3I) is a weapon system acquisition strategy formulated in the late 1970s in response to the high development costs of new systems, lengthening acquisition intervals, increasing age of current inventories, constrained budgets, and various technology trends. It is founded on the assumption that quality enhancement modification of existing inventory systems is a cheaper and quicker way to modernize than the development of entirely new systems. The P3I strategy is aimed at facilitating this process; its central element is the design of new systems from their origins to accommodate future

quality upgrades. Discussion of the merits and disadvantages of P3I, however, remains abstract and theoretical. This Note reviews the circumstances that led to the formulation of P3I, clarifies the implications of the concept and offers an initial assessment of the policy as applied to aircraft systems based on a careful and extensive examination of past major aircraft modification efforts. The authors conclude that long-range pre-planning during the design stage is impractical. 69 pp.

N-1795-AF F100 Engine Capability Assessment in PACAF: Effects on F-15 Wartime Capability. M. J. Carrillo, R. A. Pyles. March 1982. Not Reviewed for Public Release.

The Dyna-METRIC model of component repair and supply processes was used to forecast how planned and actual support for the F100 engine would affect F-15 wartime capability in a PACAF scenario. Some engine support problems were found whose implications extend beyond that specific scenario. First, F-15 wartime capability under a standard support structure was found to depend critically on the early availability of continuous Jet Engine Intermediate Maintenance (JEIM). The PACAF Centralized Intermediate Logistics System was found to compensate cost-effectively for delayed JEIM deployment, given the planned wartime intra-theater transportation times. Second, different goals and assumptions in the various plans that affect F100 engine support were found to provide imbalanced levels of support. Finally, actual F100 engine demand, repair, and stock levels were found to degrade that engine's current support of PACAF F-15 wartime capability. 31 pp. Ref.

N-1797-AF An Integrated View on Improving Combat Readiness. M. D. Rich, S. M. Drezner. February 1982.

This Note describes a new approach for identifying and meeting the need to improve combat readiness. That approach rests on three basic ideas. (1) Readiness can be assessed only within the context of explicit wartime scenarios, a requirement that renders most popular characterizations of readiness (e.g., availability rates) inappropriate and misleading. (2) Readiness is the product of many factors, including the weapon system's characteristics, the expected stocks of support resources in wartime, and the performance of support systems. (3) Sophisticated equipment is not inconsistent with the goal of high levels of readiness, even in the face of increasingly demanding and stressful combat environments. Achieving that goal, however, will require new, effective support policies, and will require major changes in the customary subsystem and full-system acquisition process. 28 pp.

N-1799-AF Tactical Night/Adverse Weather Ground Attack Capability in a European Environment: Visual and Infrared Temporal Utility Calculations (U). R. E. Huschke, L. G. Mundie, H. H. Bailey, N. W. Crawford. January 1985. Confidential.

(U) This Note analyzes the temporal utility of visual and infrared sensors used to acquire tank-size targets, calculated as a function of sensor altitude, sensor type, season of the year, and time of day or night. It also estimates the utility of these sensors in systems employing Maverick, Rockeye,

and GAU-8 weapons. The weather conditions reported hourly at Kitzingen, West Germany, from 1964 through 1970, which are assumed to be representative of those in the Warsaw Pact tactical rear, are used as a databank in the study. The basic product of the calculations is a set of tables or graphs for each sensor type and required level of acquisition probability, showing temporal utility as a function of range and altitude. Calculations and output products are also broken down by season and time of day. A related Note, N-1810-AF, contains a complete explanation of methodology and background data. 76 pp.

N-1804-AF Multiyear Contracting for the Production of Defense Systems: A Primer. E. Dews, M. D. Rich. January 1982.

This Note describes the concept of multiyear contracting in defense procurement, summarizes recent proposals and new legislation intended to widen its use and increase its utility, and outlines the criteria to be used in choosing the types of acquisitions best adapted to this mode of contracting. Its purpose is to describe and explain rather than to assess or advocate, and it emphasizes contracting for production—that is, for the procurement of end items not available off the shelf. The Note discusses basic funding-contracting modes, changes in multiyear contracting and advanced procurement, and issues of choice in applying the opportunities for multiyear procurement provided by the Department of Defense authorization act, 1982. 44 pp. Ref.

N-1810-AF Tactical Night/Adverse Weather Ground Attack Capability in a European Environment: Target Acquisition Methodology and Results (U). L. G. Mundie, R. E. Huschke, H. H. Bailey, N. W. Crawford. February 1982. Confidential.

(U) This Note describes one portion of a study of air-to-ground attack during night and adverse weather conditions in the Central European theater. It is restricted to the problem of target acquisition; the performance of various sensors in this environment is estimated, together with their utility in a number of weapon systems. Section II discusses the weather problem and the manner of treating it. Section III estimates the performance of the three types of sensors (visual, infrared, and radar). Section IV suggests an alternative measure of sensor utility. Section V discusses the problem of terrain masking in the acquisition of tactical targets. The conclusions are enumerated in Sec. VI. 156 pp. Ref.

N-1820-AF TSAR User's Manual: Vol. I, Program Features, Logic, and Interaction. D. E. Emerson. February 1982.

This Note is one of five documents that collectively describe the TSAR and TSARINA computer models developed to assess the effect of air attacks on the sortie generation capabilities of airbases. The Theater Simulation of Airbase Resources (TSAR) model provides an analytic context within which a variety of airbase improvements may be tested. The present Note provides a full description of the logic used in the TSAR model, as well as an understanding of the interrelations among the many elements of the logic for programmers interested in modifying and ex-

tending the existing program logic. (See also R-2584, N-1460, N-1821, N-1822, P-6647.) 178 pp.

N-1821-AF TSAR User's Manual: Vol. II, Data Input, Program Operation and Redimensioning, and Sample Problem. D. E. Emerson. February 1982.

This Note is one of five documents that collectively describe the TSAR and TSARINA computer models developed to assess the effect of air attacks on the sortie generation capabilities of airbases. The Theater Simulation of Airbase Resources (TSAR) model provides an analytic context within which a variety of airbase improvements may be tested. The present volume of the User's Manual is intended primarily for those responsible for preparing input materials and for operating the TSAR simulation model. (See also R-2584, N-1460, N-1820, N-1822, P-6647.) 156 pp.

N-1822-AF TSAR User's Manual: Vol. III, Variable and Array Definitions, and Other Program Aids for the User. D. E. Emerson. February 1982.

This Note is one of five documents that collectively describe the TSAR and TSARINA computer models developed to assess the effect of air attacks on the sortie generation capabilities of airbases. The Theater Simulation of Airbase Resources (TSAR) model provides an analytic context within which a variety of airbase improvements may be tested. The present volume of the User's Manual will be useful primarily for those interested in modifying and extending the existing program logic, or trying to understand apparent errors. (See also R-2584, N-1460, N-1820, N-1821, P-6647.) 125 pp.

N-1829-AF Bounding the Costs of Hedging Against Space Shuttle Contingencies: A Policy Analytic Approach. I. S. Blumenthal. August 1983.

This Note addresses the problem of how to determine "acceptable" guidelines (or a bound) for the costs of attempting to mitigate the effects that a system shuttle shutdown could have on the space-dependent component of our national security capability. The Note uses a property loss insurance analogy from the business world in order to arrive at an acceptable monetary bound for a hedge against the shutdown contingency. It is concluded that this exploratory, general, policy analytic approach appears pragmatically useful. 39 pp. Ref.

N-1831-AF Demonstration of the Subjective Transfer Function Approach Applied to Air Force-Wide Mission Area Analysis. C. T. Veit, M. Callero, B. J. Rose. February 1982.

This Note describes an application of the subjective transfer function (STF) approach to complex system analysis to an Air Force-Wide Mission Area Analysis (AFWMAA) problem domain. Following a short description of the background that led up to the research and an overview of the STF approach, the authors discuss how the STF approach was applied to the AFWMAA problem domain of immediate targeting for battlefield air interdiction in the tactical command and control mission area. That section includes

the hypothesized structure of the problem domain; how the judgment data were gathered; the judgment models entertained as STFs to explain how the components comprising the structure affect judged outcomes; how the data were analyzed to provide information about the appropriateness of the hypothesized structure and the appropriate STFs for functionally linking the components of the structure; and how resulting STFs would be used to assess the capabilities of alternative command and control systems. Finally, the significant features of the STF approach are described and a brief summary is presented. 74 pp. Ref.

N-1840-AF Measuring and Managing Readiness: The Concept and Design of the Combat Support Capability Management System. R. A. Pyles, R. Tripp. April 1982.

This Note describes a prototype management system designed to help logistics managers assess wartime readiness and identify resources and policy changes that could dramatically improve it. The system, known as the Combat Support Capability Management System, would detect situations where theater wartime sortie capability might be jeopardized by spare parts shortages or component repair processes, and would indicate what resources or processes most degrade that capability. In addition to describing the system, this Note includes several examples of its use. 31 pp. Ref.

N-1842-AF Uncertainty in Personnel Force Modeling. G. J. Hall, Jr., S. C. Moore. April 1982.

Most military personnel planning models are deterministic steady-state models. This Note examines the impact of various types of uncertainties on projections of force structures using a Markov flow model of the first-term force. In particular, it addresses the impact of uncertainties related to the supply of enlisted Air Force personnel (stay/leave decisions by or about individual airmen, the makeup of accession cohorts, retention rate estimation, and recruiting shortfalls) on force planning factors such as accession requirements, reenlistment requirements, and personnel costs. The analysis indicates that projections of many force characteristics can involve sizable uncertainties. Individual stay/leave decisions comprise the largest source of this uncertainty. Another potentially larger contributor is uncertainty in the proportion of accession requirements that can actually be met. Uncertainties regarding estimates of flow rates, while important in projecting values for certain subsets of the force, appear to contribute little to uncertainty in overall force characteristics. 107 pp. Ref.

N-1850/1-AF Tactical Air. Challenges for the Future: Theater Air Defense (U). C. T. Kelley, Jr., E. M. Cesar, Jr., A. A. Barbour, B. W. Don, C. B. East, W. L. Stanley. September 1981. Secret NOFORN WNINTEL.

(U) This Note discusses the need for a new fighter designed for the air-to-air combat role. It compares the air combat capabilities of existing U.S. Air Force (USAF) fighters with the capabilities of current and projected Soviet fighters, and considers the role of fighters in providing air defense in Central Europe and Third World areas. The margin of air superiority now enjoyed by current USAF fighters can be maintained for another decade by suitable modifications to

extend their capabilities in both the beyond visual range and within visual range air combat regimes. The NATO rear area air defense mission does not provide sufficient justification, by itself, for a new air-to-air fighter at this time. Fighters can be deployed faster from CONUS to Third World areas to provide air defense coverage than can surface-to-air defenses. Quick deployment of air defenses may be crucial either to protect allied forces against air attack or to provide protection of U.S. forces deploying to the theater. 150 pp. Ref.

N-1850/2-AF Tactical Air. Challenges for the Future: Air Base Attack (U). T. M. Parker. September 1981. Secret Intelligence Information.

(U) Describes the Warsaw Pact air threat to NATO in Europe and assesses potential future NATO capabilities to attack Warsaw Pact airbases. Tactical aircraft with unguided and short-range guided weapons, tactical aircraft and B-52s with long-range air-to-surface missiles, and long-range surface-to-surface cruise and ballistic missiles are considered for attacks against runways, taxiways, aircraft bunkers, and sheltered and unsheltered aircraft. A mix of aircraft, missiles, and weapons is suggested for the future. 76 pp. Ref.

N-1850/3-AF Tactical Air. Challenges for the Future: Ground Attack Analysis (U). J. W. Ellis, Jr. September 1981. Secret.

(U) This Note deals with some of the performance capabilities that will be desirable in a tactical fighter for air-to-surface attack tasks in nonnuclear operations in the late 1980s. Such capabilities will continue to be an essential element of fire support for ground forces. Characteristics considered desirable for the new aircraft are discussed. Unmanned, remotely launched vehicles promise to be a valuable complement to manned systems. 138 pp. Ref.

N-1854-1-AF The ROSS Language Manual. D. McArthur, P. Klahr, S. Narain. September 1985.

This Note summarizes the commands of the ROSS language. ROSS is an object-oriented programming language developed at RAND. The goal of ROSS is to provide a programming environment in which users can conveniently design, test, and change large knowledge-based simulations of complex mechanisms. Object-oriented programming languages, and ROSS in particular, enforce a "message-passing" style of programming in which the system to be modeled is represented as a set of actors and their behaviors (rules for actor interaction). This style is especially suited to simulation, since the mechanism or process to be simulated may have a part-whole decomposition that maps naturally onto actors. The first section of this Note gives an overall view of the language and the philosophy behind object-oriented programming. The next eleven sections give detailed descriptions of the basic commands or behaviors of the language. The final two sections give advice on how to write English-like code in ROSS and how to optimize code, once debugged. 49 pp. Ref.

N-1856-AF Right-Wing Terrorism in Europe. B. R. Hoffman. March 1982.

This Note presents an analysis of right-wing terrorism in Europe. It considers the phenomenon of right-wing terrorism—its methods, aims, and prospects. It examines the right-wing or neo-Nazi/neo-fascist organizations presently active in Italy, West Germany, and France. It analyzes the origins of recent violent right-wing activity and touches on the recent historical background of these groups, their ideology and mindset, targeting and modus operandi, international connections, and their possible effect on U.S. interests. The likely future actions of right-wing terrorists cannot be predicted, but it can be said at this time there seems to be no danger that right-wing terrorists can actually "take over" anywhere. But they can—and do—create a climate that has destabilizing effects on the countries in which they operate and therefore on the NATO alliance as well; thus, they pose an indirect danger to the security of the United States. 31 pp.

N-1858-AF Factors Affecting the Development of Space-Based Radars (U). D. S. Rubenson. June 1982. Secret NOFORN Intelligence Information.

(U) This Note examines the rationale for the development of space-based radars. It focuses on three systems: a comprehensive high-altitude space-based radar system; a low-performance, low-risk space-based radar system; and ground-based surveillance systems. These three systems are compared in continental air surveillance and aircraft carrier defense support applications. The analysis does not point to any significant advantage of a space-based system for continental air surveillance. The analysis does, however, show that as performance requirements for this mission increase, a comprehensive space-based radar begins to look more attractive. Thus, a comprehensive space-based radar may represent a far-term solution for this mission. The analysis also suggests that a low-performance, low-risk, space-based surveillance system would complement a ground-based surveillance system by providing coverage in the upper latitudes, while at the same time helping to demonstrate space-based radar technology. 32 pp.

N-1861-AF The Impact of Tanker Support on Selection of Long-Range Combat Aircraft Size. R. D. Shaver, H. G. Massey, A. A. Barbour, J. L. Birkler. September 1982.

This Note addresses the problem of long-range combat aircraft (LRCA) size selection and the impact of tanker support. It examines two possible LRCA missions (the canonical SIOP requirement and the use of LRCAs for worldwide force employment (WWFE) with nonnuclear ordnance) and airframe designs. Section II discusses the range/payload equations (with and without tankers) appropriate for SIOP-like missions. Section III describes the range shortfalls for the SIOP mission given specific airframe designs and mission-specific payload weights. Section IV translates these designs into total life-cycle costs, still concentrating on the SIOP-like mission requirements. That section presents the observations about preferred sizes for LRCA if the SIOP were the only mission to be considered. Finally, Sec. V discusses the impact of the WWFE mission on the

above observations. The appendix presents details of the cost estimates upon which the cost estimating relationships used for the analysis were based. 58 pp. Ref.

N-1870-AF A Preliminary Evaluation of a Hypervelocity Air Defense Gun (U). J. R. Hiland, J. H. Rosen, A. F. Brewer, L. N. Rowell. June 1982. Confidential.

(U) Provides first-order estimates and evaluation of electric gun performance potential in an air defense role compared with modern conventional air defense gun capability when the target is a moderately maneuvering fixed-wing aircraft. The results indicate that major performance improvements can accrue from the electric gun's high velocity and enhanced projectile characteristics provided low values of ballistic dispersion are achieved, fire-control sensor range capability is extended, kinetic energy projectile lethality problems are favorably resolved, and power supply size and output are not severely constrained by specific application requirements. The preliminary estimates are based on a simplified approximation technique where the figure of merit is probability of kill per burst. 39 pp. Ref.

N-1871-AF A Survey of NATO Defense Concepts. R. Levine, T. T. Connors, M. G. Weiner, R. A. Wise. June 1982.

As part of a larger study, a survey was conducted of articles and papers that have proposed new or different concepts for the defense of NATO. Each article was read for the author's view on three topics: why a change is needed in NATO's current defense concepts or capabilities; what the main tenets of the author's proposed concepts are; and how the concept is supposed to work. This Note presents a synopsis of the unclassified articles, selected to reflect many different views. It also categorizes the views in several ways. No attempt is made, however, to evaluate the individual proposals or to incorporate any information on possible Soviet/Warsaw Pact reactions to the proposals. The main purpose of the Note is to provide planners and analysts with an overview of the variety and scope of suggested changes in NATO defense concepts and capabilities. 71 pp.

N-1872-AF Range Enhancement Equations for Various Refueling Options. R. D. Shaver. June 1982.

This Note presents a series of simplified equations and numerical calculations indicating the magnitude of range augmentation (or, equivalently, payload enhancement for a fixed range) that refueling by tankers can provide long range combat aircraft (LRCA). The treatment is theoretical and should apply to LRCAs of various design. The Note examines several refueling conditions, including two pre-fueling tactics and two post-fueling tactics for the tanker. In addition, the author considers both pre- and post-strike refueling for the LRCA, and indicates the potential advantages in range enhancement derived from dropping the payload along the LRCA's flight path. Finally, for analytic convenience, most of the derivations and calculations contained in the Note assume that the LRCA and tanker are equal-size, being derived from the same basic airframe and engine. 65 pp. Ref.

N-1873-AF Penetration by Low Observable Aircraft (U). W. W. Matyskiela. August 1981. Secret.

(U) This study investigates how the basic parameters of radar cross-section, altitude, and velocity determine bomber penetration through advanced Soviet air defenses. The study suggests that Soviet airborne radar threats to U.S. bomber penetration can be solved by the use of the "stealth" concept. 33 pp. Ref.

N-1882-AF Development and Production Cost Estimating Relationships for Aircraft Turbine Engines. J. L. Birkler, J. B. Garfinkle, K. E. Marks. October 1982.

This Note describes RAND's latest study of cost estimating relationships for new military aircraft turbine engine development and production programs. It presents equations for estimating development and production costs and time of arrival for U.S. military turbojet and turbofan engines. The study derives new cost estimating relationships from an expanded database and uses new diagnostic statistics to screen the relationships and to evaluate the characteristics of the preferred set. Section II of this Note identifies the data used, explains the criteria and rationale for selecting explanatory variables, and describes recently developed regression diagnostics. Section III presents the preferred set of relationships. Comments on these results, a comparison with DAPCA equations, suggestions for the use of the cost estimating relationships, and directions for possible future research are discussed in Sec. IV. Supporting statistics for the predictive models are available in the appendix. 69 pp.

N-1883-AF The Taxiway Repair Schedule Problem: A Heuristic Rule and a Branch-and-Bound Solution. L. H. Wegner. October 1982.

After an attack on an airbase, the system of taxiways that connect aircraft shelters or parking areas to the airbase runway may be so damaged that some of the aircraft are not able to reach the runway. In this Note, the Taxiway Repair Schedule Problem is defined to be the problem of finding the optimal sequence for repairing the damaged taxiway sections, assuming that each section has a known repair time and that the sections are repaired one at a time. An optimal taxiway repair sequence minimizes the average time that aircraft have been denied access to the runway. Two procedures are presented for selecting repair schedules: one, a branch-and-bound algorithm, actually determines an optimal schedule, but at a high computational cost (which becomes infeasibly high for a large number of damaged taxiway sections); the second, a heuristic rule, is computationally simple but does not select optimal schedules for all problems. The two procedures are compared for 100 example problems. 31 pp. Ref.

N-1885-AF SWIRL: Simulating Warfare in the ROSS Language. P. Klahr, D. McArthur, S. Narain, E. N. Best. September 1982.

This Note describes a program called SWIRL, designed for simulating military air battles. The Note serves three purposes: (1) It is a user's guide to SWIRL. Those wishing to run SWIRL, and to some extent modify its behaviors, can use this Note as a guide. (2) The Note provides an exten-

sive example of a simulation written in the ROSS language for those wishing to examine how one might design and build a simulation in ROSS. (3) At a more general level, the Note focuses on some important techniques for constructing simulations in an object-oriented programming environment. The Note describes the design and implementation of SWIRL and includes all of the SWIRL code and documentation. SWIRL embodies an air penetration simulation of offensive forces attacking a defensive area. Objects represented include offensive penetration, defensive radars (both ground and air), SAMs, missiles, filter centers, defensive fighters, command centers and targets. 73 pp. Ref.

N-1891-AF Poland in Crisis. A. R. Johnson. July 1982.

This Note analyzes the rise of the Solidarity trade union in Poland, its suppression by martial law, and the effect on Soviet interests in Eastern Europe. The Note concludes that the martial law regime established in Poland in December 1981 is not a stable system of rule. The Soviets can hardly consider the Polish crisis over. The Jaruzelski regime has made little progress in developing a viable "normalized" political system. The Polish crisis has further undermined the legitimacy of Soviet-style political systems elsewhere in Eastern Europe. The Polish military has overshadowed the Polish Communist Party while being distracted from its external Warsaw Pact missions. And the Polish crisis has increased the potential for violent instability in the Eastern part of Europe. 57 pp.

N-1893-AF The Evolution of Armed Forces Enlisted Personnel Management Policies: Executive Summary. J. H. Hayes. July 1982.

Executive Summary of an unpublished working paper which describes the evolution of principles and procedures that guide the various branches of the armed services in managing their enlisted forces. The principles and procedures are the result of public pressures and struggles among the Congress, the Executive Branch, and the services. The struggles are traced from the creation of the Continental Army in 1776 through the next 200 years. Particular attention is paid to recruitment, retention, compensation, desertion, punishment, drinking, and race. (See also R-2276.) 114 pp. Bibliog.

N-1906-AF Fast Concurrent Simulation Using the Time Warp Mechanism, Part I: Local Control. D. R. Jefferson, H. A. Sowizral. December 1982.

More than 20 years after its development, computer simulation continues to be a time-consuming process. This Note addresses the problem of speeding up simulation through concurrency. The authors propose a new method for concurrent simulation. The Note first presents the fundamental issues in concurrent discrete event simulation. A critical analysis of the methods for concurrent simulation proposed in the literature follows. Then the authors give a detailed description of the local control part of the time warp mechanism, the part concerned with the actual mechanics of discrete event simulation. Finally, the discussion examines the concepts of messages, antimessages, annihilation, and rollback. 56 pp. Ref.

N-1908-AF Technological Perspectives for Air Base Communications. W. H. Ware. October 1985.

This Note examines the relevance of contemporary local area network (LAN) and computer-based digital telephone switch technology to the needs of CONUS airbases, in both the near term and far term. It suggests possible architectures based on such technology and concludes that in the next decade a hybrid arrangement will provide the flexibility and adaptability that differences in requirements among bases demand. The Note also considers the security aspect of handling classified information in base-level communications and concludes that security issues in a LAN-oriented base will be awkward for several years ahead. It suggests, however, that commonsense actions can be taken that will help make base communications more secure, and describes several new National Security Agency-sponsored programs that will make it possible to provide secure on-base telephone and data communications. It makes two major recommendations: (1) that a policy statement be developed outlining the context, assumptions, and guidelines for improving base communications in the next decade; and (2) that a comprehensive plan be drawn up to guide the Air Force on an evolutionary path to improved airbase communications. 133 pp.

N-1924-AF Israeli Military Medical Experience: Ideas for the U.S. Air Force's Medical Service? G. A. Goldberg. August 1982.

Based on selective conversations with Israeli physicians, nurses, and administrators, the Note describes facets of Israeli military medical organization, functioning, and thinking that might be applicable to the U.S. Air Force. Some of the major strategies the Israelis have used to manage war-time casualties include (1) triage carried out in several stages, preferably by senior physicians; (2) a carefully designed casualty dispersal plan with ramifications for the types of services various facilities should be able to provide; (3) pre-delegating tasks and pre-assigning the type of setting where they will be performed; (4) pre-conflict rehearsal of functioning by the individual and by teams; (5) re-thinking which physician specialists can perform various procedures; and (6) changes in organization, procedure, equipment, etc., right now, not in time of war. 32 pp. Ref.

N-1926-AF The Reliability of Soviet Aircraft (U). J. T. Quinlivan, J. B. Hall, D. E. Lewis, R. M. Paulson. March 1983. Secret NOFORN WNINTEL.

(U) This Note discusses the reliability of Soviet aircraft. It gives a description of the data and classification of events, looks at unscheduled and scheduled (phase) maintenance, the total maintenance man-hour requirements, and compares these with Soviet current inventory aircraft. 59 pp. Ref.

N-1937-AF Future Airbase Attack Capabilities: A Briefing (U). T. M. Parker. December 1982. Secret Intelligence Information.

(U) Presents the text and charts of a summary briefing of the results of a survey and assessment of potential future NATO capabilities for attacking Warsaw Pact airbases with

conventional weapons. Tactical aircraft with various unguided and short-range guided weapons, tactical aircraft and bombers with medium-range air-to-surface cruise missiles, and long-range surface-to-surface cruise and ballistic missiles are considered for attacks against runways, taxiways, aircraft shelters, and sheltered and unsheltered aircraft at main operating bases. The results suggest the utility of a mixed force. 29 pp. Ref.

N-1937/1-AF Future Airbase Attack Capabilities: A Briefing (U). T. M. Parker. December 1982. Secret Intelligence Information NATO Releasable.

This is a NATO-releasable version of N-1937. 26 pp.

N-1938-AF The Red Strategic Campaign Analysis. Possible Soviet Views of Risks and Uncertainties of Strategic Nuclear Conflict: Summary (U). R. D. Shaver, P. D. Gardner, W. E. Hoehn, Jr., P. M. Kozar, M. D. Mihalka. May 1983. Secret.

(U) This Note summarizes a pioneering effort to develop a methodology for integrating the Soviet perspective on strategic force operations into analyses of the strategic relationship between the United States and the Soviet Union. Special emphasis was placed on whether assessments using Soviet methodologies yield results consistent with U.S. assessments of the balance, and on what risks and uncertainties confront Soviet military planners when they contemplate the use of strategic nuclear forces. 25 pp.

N-1943-AF Improving U.S. Capability to Deploy Ground Forces to Southwest Asia in the 1990s: A Briefing. P. M. Dadant. February 1983.

An examination of both conventional and unconventional methods of improving U.S. capability to project forces in the 1990s. Southwest Asia is used as an example destination. The study compares mobility system additions of equal 20-year life cycle costs, both quantitatively for speed in projecting forces and qualitatively for ability to quicken deployment with warning, feasibility, our confidence in cost estimations, and the vulnerability of ports, but does not compare the vulnerability of vehicles. Lighter-than-air ships, surface effect ships, and floating airbase prepositioning are included in the comparisons. Only prepositioning allows really quick deployment, but the study concludes that no single system supplies all desirable attributes without risks and drawbacks. The Note shows the performance of two mixed systems; the methodology developed permits comparison of other mixes. 24 pp.

N-1968-AF Procurement of Air Force Physicians: Scholarship or Direct Recruiting. S. Hosck. July 1983.

This study evaluates direct physician recruiting in light of recent trends in civilian physician incomes and other market indicators, compares the cost savings to the Air Force of direct recruiting over the Armed Forces Health Professions Scholarship Program (AFHPSP), and reviews general supply trends in the U.S. physician market. Despite military physician pay increases and an increasingly competitive civilian market, the volunteers continue to be a heterogeneous group. The AFHPSP program represents a more

stable procurement source than direct recruiting in both numbers and composition, but it is also more expensive. The comparison made in this Note of the cost-effectiveness of the AFHPSP and volunteer programs must remain tentative without further information. 34 pp. Bibliog.

N-1973-AF Non-Nuclear Air-to-Surface Ordnance for the Future: An Approach to Propulsion Technology Risk Assessment. W. P. Hutzler, J. R. Nelson, R. Y. Pei, C. Francisco. February 1983.

Proposes a risk assessment method that addresses the likelihood of achieving technological advances for particular military hardware by quantifying (1) the technological state of the art of that hardware and (2) the probability of achieving that program relative to past experiences with similar programs. The hardware considered in this research for state-of-the-art trending and risk assessment includes man-rated aircraft turbine engines, solid rocket motors, and non-man-rated missile and drone turbine engines. Preliminary evaluation of the various models indicates that, for the most part, the results agree with what engineers would expect concerning variables that are important to the trend of the technologies and to the outcomes for particular programs. 52 pp. Bibliog.

N-1974-AF The Applicability of Statistical Regression Techniques to the Prediction of Performance Trends in FLIR Sensors (U). L. G. Mundie, H. H. Bailey, J. B. Garfinkle. April 1983. Confidential.

(U) This study examines the applicability of statistical regression techniques to the prediction of performance trends in forward-looking infrared (FLIR) sensors. An historical database was compiled and examined for such trends, in a manner similar to that which had been used, with considerable success, in predicting the performance of aircraft engines. In the case of FLIR sensors, however, no such trends were detectable. It is concluded that performance prediction for FLIR sensors can better be accomplished by extrapolation from present performance, guided by a knowledge of developments now in the research stage. 29 pp. Ref.

N-1976-RC/AF Mini-TRIM Applications (U). L. N. Rowell, J. A. Dewar, C. L. Freeman, K. J. Hoffmayer, W. S. King. July 1983. Secret Intelligence Information.

The title of this document describes its content. 39 pp. Ref.

N-1983-AF The Soviet View of the Future of PRC Security Constraints (U). H. Gelman. April 1983. Secret NOFORN WNINTEL.

(U) This Note complements R-2943, *The Soviet Far East Buildup and Soviet Risk-Taking Against China*, August 1982, which examined the factors that successively influenced the evolution of the Soviet buildup in Asia under the Brezhnev regime and sought to track the changing Soviet view of the risks involved in the use of force against the People's Republic of China. This Note explores issues of the strategic triangle, implicit in the discussion and conclusions of R-2943, that could not be dealt with in any detail in an unclassified context. 31 pp.

N-1985-1-AF Increasing Future Fighter Weapon System Performance by Integrating Basing, Support, and Air Vehicle Requirements. M. B. Berman, C. L. Batten. April 1983.

Argues that the Air Force should consider alternative basing and support characteristics before completing concept formulation for the Advanced Tactical Fighter. In so doing, the Air Force could integrate these characteristics using a methodology described in this Note. This methodology aims at identifying the best match between specific air vehicle characteristics and such basing and support improvements as dispersed and/or rearward basing, short-take-off-and-landing and rough-field-landing capabilities, increased combat range capabilities, improved equipment reliability, and decreased reliance on support equipment and personnel. The proposed methodology involves two stages: (1) identification of necessary individual improvements paid for with the least money and the least decrease in overall aircraft performance, and (2) integration of all improvements to ensure the greatest overall weapon system improvements. This integrated approach implies a new definition of "weapon system performance," one that involves not merely air vehicle characteristics (like velocity and acceleration) but also basing and support characteristics. 25 pp.

N-1990-AF A Methodology for Evaluating Air Force Physicians' Peacetime and Wartime Capabilities. J. L. Buchanan, S. Hosek. July 1983.

Documents a methodology for analyzing problems incurred in planning an Air Force Medical Service serving complementary and conflicting functions. The Note describes a mathematical programming model called the physician workforce design model, which complements the Provider Requirements Integrated Specialty Model (PRISM) developed by the Air Force. The model and methodology identify and compare options for improving the wartime capabilities of active duty physicians without compromising the peacetime delivery of health care. By pursuing the more promising options, the Air Force can improve its readiness to respond in a sudden conflict within the constraints of a workable peacetime health care system. The Note describes the dual purpose workforce design model and the wartime capability assessment model, and defines the workforce model inputs. 29 pp. Ref.

N-1995-AF The New Soviet Strategy in the Third World. A. R. Alexiev. June 1983.

This study sets forth in broad outline several major changes observable in recent Soviet strategy for penetration in the Third World, details the specific instrumentalities of the Soviet quest for leverage, and addresses some of the Soviet Union's strengths and weaknesses. Section II traces the origins and evolution of Soviet Third World policies up to the early 1970s and examines the causal factors and circumstances leading to a reassessment of Soviet policies and the formulation of a new strategy. Section III highlights the international circumstances and Soviet military-political realities providing incentives for the new approach and analyzes its doctrinal-ideological framework. The specific methods and instrumentalities—military, political, and economic—of Soviet penetration of the Third World under the

new strategy are addressed in Sec. IV. The main conclusions are presented in Sec. V. 40 pp.

N-1998-AF Forward Response: A New Concept for NATO Defense (U). M. G. Weiner, E. M. Cesar, Jr., T. T. Connors, J. W. Ellis, Jr., R. A. Wise, L. H. Wegner. October 1983. Secret Restricted Data NOFORN Intelligence Information.

(U) This Note describes and analyzes a new defense option for NATO called "Forward Response." It covers three main topics: Section I describes and assesses the effectiveness of NATO's current defense concept; Sec. III describes and assesses the Forward Response option; and Sec. IV presents observations about the Forward Response option and the issues of effectiveness, enemy countermeasures, and implications for the role of airpower. Ten appendixes present supporting material on the assessment methodology, data, and analyses of this study. 206 pp. Ref.

N-2001-AF The Polish Military After Martial Law: Report of a RAND Conference, October 14, 1982. A. R. Johnson, B. A. Kliszewski. June 1983.

The aim of the conference reported on in this Note was to consider the role of the Polish military after the proclamation of martial law on December 15, 1981; the military and political background to the events of 1981; and the implications for the future of the Polish armed forces, both in the Polish Communist system and in the Warsaw Pact. This Note summarizes key themes that emerged from the discussion. It also presents a condensed record of the discussion and summarizes the views of individual participants. 33 pp.

N-2002-AF San Antonio Real Property Maintenance Area: Overview of a Regional Consolidation of Base Support Services. H. G. Massey. May 1983.

This Note reports on a survey of operating experience in the San Antonio Real Property Agency (SARPMA)—an organization formed to consolidate buildings and grounds maintenance functions for four Air Force bases, an Army post, and several smaller, auxiliary facilities in and around San Antonio, Texas. The information collected in the survey suggests that SARPMA is probably not achieving the primary purpose of the consolidation—to provide real property maintenance services to its customer bases at lower cost to the government. The centralized organization is less responsive to providing services than conventional, base-level organizations, and it is less sensitive to the urgency and priorities of the bases' requirements. Management innovations and improvements have been and are being undertaken, but some of these can probably be applied to base-level organizations and provide similar benefits without requiring consolidation. The conclusions regarding costs are tentative because no full cost analysis of SARPMA operations has been done. 25 pp.

N-2005-AF Conceptual Design of an Enlisted Force Management System for the Air Force. G. M. Carter, J. Chaiken, M. P. Murray, W. E. Walker. August 1983.

This Note provides a description and assessment of the Air Force's current enlisted force planning and programming system, and concepts and recommendations for the development of an improved system. The new system has been designed to overcome the deficiencies and enhance the capabilities of the present system. Because many enlisted force management activities have good support systems, the recommended system will be directed toward grade restructuring, personnel planning, and personnel programming. 132 pp.

N-2007-AF Surveillance Requirements for Countering Tactical Ballistic Missiles (U). K. P. Horn, J. G. Bolten, D. S. Rubenson. November 1983. Secret NOFORN WNINTEL.

(U) This Note reports on a briefing which investigated surveillance requirements for countering the Soviet tactical ballistic missile (TBM) threat in Europe. Three means that use missile surveillance information are proposed—passive defense for survival actions, active defense for antitactical ballistic missiles, and counterbattery strikes for attacking the missile launchers. After a review of the Soviet TBM threat, various means of countering the TBMs are proposed that use surveillance information. Next, candidate surveillance system concepts are described, and the performance of each system is analyzed using a missile-radar encounter simulation model. The conclusions and recommendations are derived from the results of the performance analysis. 39 pp. Bibliog.

N-2008-AF Hard Targets and Hard-Target Munitions (U). A. Laupa. May 1984. Secret NOFORN WNINTEL.

(U) This Note examines and compares the effectiveness of both current-inventory and possible future conventional munitions against hard targets. Future weapons include all recently proposed hard-target weapon concepts and the generic weapon systems they represent. The Note studies the performance tradeoffs that are possible within constant-weight weapons of each generic type and compares the performance of equal-weight weapons of different generic types. 72 pp. Ref.

N-2023-AF A Fortified Barrier Option for the Defense of NATO (U). M. G. Weiner, T. T. Connors, L. H. Wegner. September 1984. Secret NOFORN Intelligence Information.

(U) This Note examines one of several alternatives to NATO's current defense concept: a fortified barrier along the border between the Federal Republic of Germany (FRG) and the German Democratic Republic. The primary function of the barrier would be to inflict sufficient attrition on the enemy that even if he breached it, he would be unable to advance much further into the FRG against NATO's other forces. The barrier considered here consists of major and continuous fortifications incorporating advanced sensors, command-control-communications, and weapons in a zone approximately 20 km wide. The authors conclude that such a barrier would limit Warsaw Pact capabilities for surprise attack and "blitzkrieg" operations and could lessen NATO air power dependency on early generation of a large number of close air support sorties. 73 pp. Ref.

N-2026-AF Concepts of Operations: A More Coherent Framework for Defense Planning. G. A. Kent. August 1983.

This Note establishes the utility of concepts of operations as the central feature of a more logical and coherent framework for planning. The overall framework involves six levels of activity, each of which takes place in a specific organizational setting. The activities proceed from the definition and announcement of national security policies' objectives, strategies, and commitments to the development of operational plans and deployment and employment of forces. The organizational meetings range from the National Security Council to the operational commands. The Note focuses on Levels III (formulation of operational concepts to attain specific operational capabilities) and IV (development and acquisition of systems and equipment). An appendix offers an exemplar package for Levels I and II. No new directive is required for adoption; the framework need only be used. 32 pp.

N-2027-AF Perspectives on Oversight Management of Software Development Projects. W. H. Ware, R. L. Patrick. July 1983.

An examination of the problems of oversight management of large, important software development projects, i.e., management at levels above that of direct project execution. Senior managers must recognize events in the evolution of the project that might provide high leverage for maximizing the return on their invested time (in knowledge, status, or outcome projections), and that provide insight into project status and clues about possible problems. The Note attempts to identify the unique needs of oversight managers, to indicate how they have been met in industrial environments, to enumerate what working supervisors and project managers must do differently if they are involved with large projects requiring oversight management, and to list what must be done (generally) to build software tools that supply information for oversight management as a by-product of the development process. While the discussion is based on industrial experience, it is also relevant to Air Force oversight management and review. 50 pp.

N-2032-AF Homing Bullets: A Preliminary Study of a Novel Defense Weapon System (U). W. B. Graham. March 1984. Secret.

(U) This Note discusses a concept for the active defense—through "homing bullets"—of tactical fighter-bombers against surface-to-air missiles (SAMs). It argues that self-contained protection, in a nonnuclear environment, based on the active interception of long-range, high-altitude SAMs, may be more practicable than is generally believed. 86 pp.

N-2038-AF A Framework for Planning the Employment of Air Power in Theater War. E. L. Warner, G. A. Kent. January 1984.

This Note argues for the utility of developing and adhering to an explicit overall framework to guide the use of air power in support of U.S. military strategies. It offers a conceptual framework to inform Air Force planning for the de-

velopment of concepts of operations that can assist in acquisition of equipment and the formation of organizational elements. The main feature of the framework is its identification of the range of functions—surveillance, assessment, command, control, asset generation, and engagement/attack—that must be executed sequentially and repetitively to perform effectively key air power missions. The framework can be used to develop concepts of operations for the application of air power across the full range of strategic and tactical missions. In this Note, however, discussion is confined to its applicability in the context of a major theater conflict fought with conventional weapons. 35 pp.

N-2042-AF Chemical Warfare: Deployment of Air-Delivered Chemical Munitions (U). W. E. Naslund, M. Callero, S. B. Coleman. October 1984. Secret.

(U) This Note reports work done on the wartime deployment of U.S. air-delivered chemical munitions. It analyzes the processes involved in the air movement of air-delivered chemical weapons to the European theater of operations and examines airlift requirements to perform such a deployment. It suggests alternatives to speed up the process as a way to enhance the U.S. and NATO chemical retaliatory posture. The research concludes that the actions that could improve the existing chemical deployment process are primarily procedural changes to current notification actions and logistics management practices. 27 pp.

N-2051-AF Sweden's Air Base 90 System: Logistics Aspects of Interest for the United States Air Force (U). M. B. Berman, C. L. Batten. December 1983. Secret NOFORN WNINTEL.

(U) This Note describes Sweden's Air Base 90 System and the equipment needed to operate it. BAS 90 calls for the semi-autonomous operation of small units of tactical aircraft. This system aims at decreasing vulnerability to enemy attack and increasing flexibility and mobility to operate from a large number of austere locations. This system can provide the United States insights if it decides to operate future aircraft from dispersed or austere locations. 19 pp.

N-2052-AF Politics and the Soviet Presence in the People's Democratic Republic of Yemen: Internal Vulnerabilities and Regional Challenges. L. Mylroie. December 1983.

Since its independence in 1967, the People's Democratic Republic of Yemen (PDRY) has posed various challenges to the conservative pro-Western states of the Arabian peninsula, and thus, indirectly, to the United States. This Note describes the evolution of the PDRY's internal political and economic situation and discusses its relations with other states in the region and with the Soviet Union. It also discusses potential changes in the PDRY's relationships with the Soviet Union and with the conservative Arab states and analyzes various U.S. options in relation to the PDRY. The United States can play a background role: U.S. policies that enhance the conservative Arab states' sense of security will contribute to greater rigor in their dealings with the PDRY. In addition to strengthening the PDRY's

neighbors, the United States might, in the proper circumstances, consider playing a subsidiary role in the South Arabian detente itself. 72 pp. Bibliog.

N-2054-AF How Differences in Allied Security Concerns Affect Theater Nuclear Employment (U). J. C. Wendt. September 1985. Secret Formerly Restricted Data NOFORN WNINTEL.

(U) Any alliance between sovereign nations reflects certain differences in national interests, but the overwhelming commonality of interests among the NATO partners has led to an extraordinarily strong and enduring relationship. Clearly the Allies have much to gain by emphasizing these commonalities and much to lose by allowing differences to divide them. Rather than accentuating the differences in security concerns among the allies, this Note helps make clear the nature of these differences and their consequences for U.S. and NATO nuclear policy. To do this, the author examines the effect of differences in the strategic circumstances of France, the United Kingdom, and the Federal Republic of Germany on the development of NATO nuclear employment doctrine and discusses the possible consequences of these differences for actual nuclear employment. He concludes that, in an uncertain environment, made more uncertain by the unpredictability of the allies, the U.S. goal should be greater flexibility and endurance of U.S. theater nuclear systems. 43 pp.

N-2057-AF Soviet Tactical Sortie Generation: Vulnerabilities, Costs, Payoffs (U). D. E. Lewis, R. M. Paulson, C. B. East, H. G. Massey, J. T. Quinlivan, J. C. Wendt. January 1984. Secret Intelligence Information NATO Releasable.

(U) This briefing summarizes the major assessments of a project designed to evaluate the capabilities and identify the vulnerabilities of specific components of the Soviet Air Force. Soviet air regiments' flying and maintenance attributes were simulated. The simulations replicated the interaction of the Soviet infrastructure and the equipment and personnel support resources of the units. They were evaluated in the context of the best estimates of a set of plausible Soviet employment plans. The Note identifies apparent vulnerabilities of the regiments, what the costs would be in terms of effectively exploiting them, and the payoffs in terms of reduced Soviet sorties. 36 pp. Ref.

N-2058-AF Profiles of the Caribbean Basin in 1960/1980: Changing Geopolitical and Geostrategic Dimensions. J. H. Stodder, K. McCarthy. December 1983.

This Note surveys changes that occurred in the various geopolitical and geostrategic dimensions of the Caribbean Basin in two time periods: 1960 and 1980. Although different parts of the database have appeared in several sources, the Note for the first time synthesizes and assesses this information in ways that readily identify major changes and trends in the Basin—often dramatic—that took place during the two decades before the Central American crisis and increased U.S. involvement in that part of the Basin. The areas looked at include political, economic, demographic, and military profiles, as well as Soviet and Cuban presence. 79 pp.

N-2060-AF Soviet Conciliation of China: Possibilities and Probable Limits (U). H. Gelman. November 1983. Secret NOFORN WNINTEL.

(U) This Note examines the geopolitical issues that now obstruct a fundamental improvement in Soviet relations with the People's Republic of China (PRC), and assesses the limits of the concessions that the Soviet Union is likely to make to China over the next few years to achieve such an improvement. On each of the major issues concerned—the Soviet force posture in the Far East and Mongolia, the Soviet position with regard to Vietnam and Indochina, and Soviet behavior in Afghanistan—the author considers in some detail the factors imparting momentum to existing Soviet policy as well as considerations that might produce change. The study weighs concessions that the Soviet leaders will probably demand of the PRC as prerequisites for Soviet concessions, and on this basis draws net conclusions as to the likelihood of change in the 1980s. 45 pp.

N-2086-AF Modeling the Demand for Spare Parts: Estimating the Variance-to-Mean Ratio and Other Issues. J. S. Hodges. May 1985.

Mathematical models are commonly used to study the performance of the Air Force's spare parts supply and repair systems. But accurate evaluations of supply policies are not possible without accurate models of the demand process for spare parts, and models that understate the variability in the demand process will bias evaluations in favor of policies that assume accurate predictions of part failures. This Note examines the model for part failures used in the RAND Supply System model, Dyna-METRIC. The ability to predict levels of parts failures is strongly affected by at least two types of uncertainty: about the numbers of failures that will occur assuming the model is correct, and about the adequacy of the model as an approximation of the demand process for spare parts. The author suggests that a model that allows more variability, such as a negative binomial model, would be more appropriate for dealing with the first type of uncertainty, and the second type can be accommodated, in part, by using models with more parameters. 41 pp. Ref.

N-2087-AF Dyna-Sim: A Nonstationary Queuing Simulation with Application to the Automated Test Equipment Problem. L. W. Miller, R. E. Stanton, G. B. Crawford. July 1984.

This Note describes the Dyna-Sim model, which provides a capability for exploring the implications of maintenance repair queuing for spare parts requirements. Use of the Dyna-Sim model to study the Automated Test Equipment (ATE) problem led to the conclusion that the "ample server assumption" (i.e., that there are more than enough ATE available to serve any repair demands) is misleading for situations where queues become saturated in high sortie rate scenarios. The authors also used Dyna-Sim to show that in a constrained server problem, the choice of the repair time distribution is not important. This permits use of exponential repair distributions in the development of tractable analytical approximations to queuing models. 59 pp. Bibliog.

N-2090-AF Developing U.S. Strategies for the Pacific: An Interim Report (U). J. A. Winnefeld, C. H. Builder, Y. F. Fukuyama, M. H. Graubard. June 1984. Secret Intelligence Information.

(U) This Note describes the results of research now in progress to assist the Air Force in formulating alternative strategies for Pacific force planning in the early 1990s. As a means for identifying the critical force planning assumptions, two teams were asked to design and justify force postures at the upper and lower bounds of possible force levels in 1990. The teams did not differ in their assumptions about the economic importance of the Pacific, the military importance of Northeast Asia, or the expected role of China. But they differed sharply in their assumptions about Soviet objectives and behavior, the likely nature of conflict between the United States and the USSR, and U.S. interests in the Pacific in the event of a global war. Their force postures differed mostly in the size of U.S. ground forces and offensive strike aircraft in the Pacific. 121 pp. Bibliog.

N-2098-AF A Data Base for Nuclear Weapon Employment Analyses (U). T. M. Parker. August 1983. Secret Restricted Data NOFORN WNINTEL.

(U) Includes the numbers, locations, characteristics, and availability of all nuclear-capable land-attack forces and nuclear weapons that might be employed in a NATO-Warsaw Pact war. Also included are the numbers, characteristics, locations, and nuclear vulnerabilities of NATO and Warsaw Pact ground forces, aircraft and airfields, surface-to-surface missiles, naval bases, and nuclear weapon storage sites as a function of time after mobilization and war outbreak. The database is developed for 1982 and the late 1980s. 197 pp. Ref.

N-2102-1-AF Future Military Applications for Knowledge Engineering. S. C. Bankes. July 1985.

This Note surveys the technology of knowledge based systems, or knowledge engineering, to identify potential military applications. The number of potential applications is quite large, and includes decision support systems, knowledge-based simulations, training aids, maintenance advisers, robotic applications. Because the technology is new and untested, there are a number of risk factors: it is unclear how costs will increase with the size of any given project; debugging and verification may be more difficult than in traditional software engineering; support resources (hardware, software, and skilled personnel) will have to be developed before this technology can be widely applied. To facilitate the parallel development of fundamental research and practical development, the author recommends selecting key applications for actual system development and, to avoid costly failures, suggests that an evolutionary strategy be employed. Knowledge-based systems should be designed to augment human capabilities, not replace personnel. 51 pp. Ref.

N-2123-AF Soviet Sortie Generation: The Database (U). R. M. Paulson, D. E. Lewis. December 1984. Secret NOFORN WNINTEL.

(U) This Note provides basic information about the Soviet sortie generation process and indicates the sources from which the authors derived their data and observations. In addition to fundamental data, it contains the results of what could be termed an "intermediate analysis" of Soviet sortie generation, one concerned not with determining overall capabilities and vulnerabilities, which was the objective of the authors' final analysis, but with making reasonable assumptions about Soviet equipment, procedures, and organization, to the extent permitted by the vast array of sources they examined. 39 pp. Bibliog.

N-2137-AF The Utility of SSTS: A Quantitative Assessment of the Space Defense Segment (U). D. S. Rubenson, J. G. Bolten, J. L. Bono, K. P. Horn. December 1984. Secret NOFORN WNINTEL.

(U) The United States currently maintains orbital data on all known space objects through a worldwide system of ground-based radars known as the Space Surveillance Network. These radars adequately perform this peacetime cataloging mission. Over the past few years, increased emphasis on the U.S. military use of space has led to concern about the adequacy of the Space Surveillance Network in a warfighting environment. These concerns have raised interest in a Space Surveillance Tracking System (SSTS), which would possibly consist of three or four long wavelength infrared sensors deployed in 5600 n mi altitude equatorial orbits. By its very nature, such an ambitious space system would be costly and risky. To justify its deployment, there would have to be significant advantages over the Space Surveillance Network or any alternative system. This Note is an attempt to measure the relative advantages of having an SSTS system. 41 pp.

N-2153-1-AF Latin American Terrorism: Violence by Anti-Castro Cubans (U). B. R. Hoffman. July 1987. Confidential.

(U) This Note presents a case study of the anti-Castro terrorist movement, which has been active in the United States for nearly twenty-five years. The exiled terrorists have attacked the diplomatic, commercial, and cultural interests of Cuba and other countries having relations or trade with Cuba, outspoken Cuban-American emigres who do not agree with them, and U.S. businesses dealing with Cuba. This case study details and integrates the information on this terrorist movement. It examines the historical background of the anti-Castro terrorist organizations, the role of Dr. Orlando Bosch (the movement's preeminent figure), and the most important individual terrorist groups. It analyzes their operations, modus operandi, targeting patterns, demographic characteristics, ideology, and mindset. It also examines their methods of communication, sources of funds, logistical organization, and relations with above-ground support. An appendix contains a chronology of their activity. 123 pp. Bibliog.

N-2162-AF Information Systems: The Challenge of the Future for the Air Force Communications Command. S. M. Drezner, W. H. Ware. May 1984.

This Note examines the future of the Air Force Communications Command (AFCC). Because of recent changes in organizational alignments of data automation and communications, the following are some of the significant changes in AFCC posture and capability that will have to be made: (1) AFCC can and should make a force multiplier available to decisionmakers in the form of information systems that can provide timely status and option information; (2) AFCC should be reorganized to become the focal point within the Air Force for communication system and functional-area information system matters; (3) it should be the entity that determines requirements and advocates improvements for common-user communications systems and develops functional-area information systems; (4) it must carefully and deliberately oversee the training and career progression of the recently combined communications and computer career fields; and (5) it must acquire the capability to perform systems analyses and other technical studies that support its proposals and relate them to mission effectiveness. Other issues related to the AFCC are discussed in N-2164. 13 pp.

N-2164-AF Base Communications Issues for the 1980s. W. H. Ware, R. M. Paulson, M. M. Balaban. September 1984.

This Note examines the role of the Air Force Communications Command (AFCC) in providing base-level communications, including transmission and reception of voice, message, and data traffic and support of automatic data processing (ADP). It identifies some of the problems faced by AFCC in planning for systems that will meet future intra-base and base/off-base communications requirements within the current structure of Command-level controls. It recommends that the AFCC do the following: (1) create a forum for adjudicating competing user needs and generating a comprehensive statement of user requirements; (2) create a computer-based, online user requirements database that will be continually updated and refined; (3) examine, with support from the Electronic Systems Division (ESD), the possibility of collecting traffic characteristics and traffic-flow data for representative bases of each major command; (4) acquire the support of ESD for certain communications-related R&D tasks; (5) arrange with other commands to jointly assess the usefulness of contemporary communications equipment; and (6) revise its mission statement to reflect the broader, more responsible mission it must have for the Air Force. That broader mission is summarized in N-2162. 38 pp.

N-2165-AF Industrial Development of Siberia and the Soviet Far East. D. Pinsky. September 1984.

During the 1980s the Soviet leadership will be forced to cope with a growing energy shortage in the western industrialized core of the USSR by accelerating the extraction of fuel and raw materials east of the Urals. The major issue of Soviet policy is and has been the debate over the appropriate nature and pace of economic development for the eastern regions--whether to maintain concentration on the fuel energy complex or to attempt balanced development across industries and between eastern and western regions. Although official declaratory policy continues to call for

balanced "comprehensive" development, the energy-fuel focus has, if anything, increased. Given the general investment constraint the Soviet leadership is now facing, combined with the Soviet leadership's resistance to reform and change, it is unlikely that there will take place the major shift and restructuring of investment for regions east of the Urals that a balanced economic development would require. 79 pp. Bibliog.

N-2171-AF PACCS Airborne Alert Sustainability (U). N. Y. Moore, P. K. Dey. February 1985. Secret.

(U) This Note analyzes the sustainability of the Strategic Air Command Post Attack Command and Control System (PACCS) during an airborne alert. Such an alert would occur in the event of a period of prolonged tension preceding a likely nuclear attack on the continental United States. The study relates the PACCS fleet's ability to perform its numerous command, control, and communications missions to the availability of aircraft, spare parts, and other logistics resources. The authors concluded that PACCS sustainability varies substantially by base, orbit, and aircraft type, as well as by both operational and support scenarios. The Air Force needs to reevaluate how long it expects to keep the PACCS airborne during a preattack alert and then take actions to ensure that the PACCS can meet the goal. 106 pp. Ref.

N-2174/1-AF Critical Issues Regarding the Viability and Utility of TAC AIR in Central Europe (U). S. M. Drezner, C. T. Kelley, Jr., N. W. Crawford, D. E. Emerson, R. J. Hillestad, K. P. Horn, R. D. Shaver, M. G. Weiner. May 1984. Secret NOFORN WNINTEL.

(U) This study provides an analytic framework for investigating currently debated critical issues regarding the survivability and usefulness of NATO TAC AIR in a 1990s Central European conflict. The key concerns addressed are: effect of Pact TBM attack, effect of follow-on air strikes, survivability of unsheltered aircraft, ability to suppress defenses and penetrate, effectiveness of NATO airbase attack, relevance of air apportionment strategy, and effect of TAC AIR on the land battle. 118 pp. Ref.

N-2180-AF Constraints on U.S. Military Strategies in Past Third World Conflicts. S. T. Hosmer. July 1984.

Assesses the principal military and political constraints that have limited U.S. military involvements in the Third World since World War II. The work represents the first phase of a study of the political and military factors that are likely to constrain U.S. strategies and combat operations in future Third World conflicts and crises, the implications of such constraints for the design and execution of U.S. strategies for meeting future challenges in the Third World, and the requirements that particular constraints may pose for future U.S. Air Force missions and capabilities. The motivations that have led U.S. decisionmakers to constrain combat operations and other military responses show striking continuity. They stem primarily from the concern to control the risks of military conflict with the USSR, limit civilian and U.S. military casualties, seek negotiated solutions to conflicts, and accommodate the policies of other nations. Successive administrations, whatever their affiliation, have

tended to base strategies more on what the United States should not or dares not do than on the optimum requirements of the actual battlefield situation. 128 pp. Ref.

N-2182-AF/RC Preliminary Investigation of Microwave Beam Weapons: A Briefing (U). A. F. Brewer. January 1985. Secret.

(U) This Note is an annotated briefing delivered to the Defense Advanced Research Projects Agency and the Air Staff in July 1984. It discusses several developments which, jointly, may make high-power microwave beam weapons realizable within a few years; highlights the major remaining problems; and provides an outline for suggested R&D to drive it to a major decision point. 15 pp. Ref.

N-2189-AF Improving Initial Logistics Support to Foreign Military Sales. G. K. Smith, N. Y. Moore, R. L. Petruschell. September 1984.

The primary objective of this study was to devise generalized procedures that would make it possible for the Air Force Logistics Command to provide initial spares support to a Foreign Military Sales customer within two years of the Letter of Offer and Acceptance (LOA) without degrading USAF capabilities. The authors broke the overall acquisition process into three mutually exclusive phases: requirements phase, procurement phase, and production phase. They concluded that the requirements phase could be compressed into approximately one year if (1) some of the program manager's work was completed while the LOA was being negotiated, and (2) the program manager was provided with an automated system for assembling, organizing, and editing the parts lists. To reduce leadtimes in the procurement phase, the authors recommend an interactive status reporting system that would highlight critical delays. Finally, the spares list should be rank ordered to ensure early delivery of the most important items. 62 pp.

N-2201-AF New Concepts for Tactical Communications: A Briefing (U). J. R. Clark. April 1985. Secret.

(U) This Note is based on a study designed to identify innovative applications of military satellite communications technologies and related systems in support of tactical forces and missions. Applications were synthesized by considering together tactical communications needs and evolving technological opportunities. Standouts among the applications identified were: a spaceborne warning and control system; an all-weather targeting system based on the NAVSTAR/Global Positioning System; remotely piloted vehicles and lighter-than-air vehicles as communication gapfillers and alternate routing nodes; and a passive transceiver for communications and surveillance. These applications, as well as the others identified in this Note, have the potential to satisfy many tactical communications deficiencies. To assess this potential, the author recommends selection of the most promising ideas, and investigation of their technical feasibility, cost, and operational concepts. 40 pp. Ref.

N-2203-AF A Direct-Ascent ASAT Countermeasure to a Space-Based Laser System: A White Team Synthesis (U). J. R. Chiesa, E. D. Harris, J. R. Hiland, H. G. Hoover

August 1985. Secret Restricted Data Intelligence Information.

(U) This Note reports the results of Red, Blue, and White Team analyses of one potentially important countermeasure to a space-based laser (SBL). This countermeasure is a direct-ascent antisatellite missile that carries a nuclear warhead and employs a high-acceleration booster to reduce the time available to the SBL for detection, tracking, and active self-defense. Such a missile has been referred to as the "Black Maria." The Note also illustrates the workings of the team structure, whose purpose is to encourage a broader, more realistic definition of possible Soviet countermeasures to a U.S. SBL deployment. The Red Team proposes countermeasures, the Blue Team verifies their credibility and elaborates on possible U.S. responses, and the White Team comments on the exchange and synthesizes the findings. The White Team believes that the Black Maria concept it has synthesized from Red and Blue inputs is a credible representation of a nuclear anti-SBL missile. 97 pp. Bibliog.

N-2205-AF Conditions for Soviet Offensive Employment of Chemical Weapons (U). R. E. Gottemoeller. June 1985. Secret NOFORN WNINTEL.

(U) This Note examines Soviet chemical warfare theory and practice in an attempt to identify Soviet policy on the use of chemicals. It also explores how that policy might apply to a Soviet first use of chemicals against NATO forces, especially NATO airbases in Western Europe. The study is based on an assessment of U.S. government reports, accounts of Soviet emigres and defectors, technical intelligence material, and Soviet open-source military literature. 57 pp. Ref.

N-2209-AF Improving MILSATCOM Acquisition Outcomes: Lease Versus Buy. P. M. Dinneen, T. H. Quinn. January 1985.

Over the next decade, military satellite communication (MILSATCOM) systems will cost taxpayers billions of dollars. The magnitude of these costs and their distribution in the economy will be directly affected by whether public policymakers choose to lease or buy these systems. This Note examines the arguments of leasing's opponents and proponents, and the conclusions suggested by past leasing experiences. The analysis demonstrates that by far the most important consideration in deciding whether to lease or buy MILSATCOM systems is the cost of risk-bearing, an issue that has largely been ignored in the public debate: under a purchase, risks are borne by taxpayers, whereas under a lease, they are borne by the shareholders of defense contractors. Based on their analysis, the authors suggest that the Department of Defense consider soliciting bids that specify terms for both lease and buy options on MILSATCOM systems, since the competitive bidding system has the potential to provide a great deal of information important to policy decisions in risk-bearing. 37 pp. Ref.

N-2211-AF Simple Analytic Solutions to Complex Military Problems. M. V. Finn, G. A. Kent. August 1985.

This Note documents in mathematically rigorous fashion seven models of recent military problems. These problems, for the most part independent of each other, range from optimum pattern size of a tactical munitions device to the most effective allocation of interceptors in a multilayered strategic defense. Other topics considered include a game theoretic solution for mixing between two offensive systems; the optimal deployment of missiles in a multiple aim point scheme with a symmetrical agreement limiting the number of warheads and, in the case of a fixed enemy threat, an algorithm for determining the cost-effectiveness of aircraft penetration aids; and the optimal number of short-range attack missiles on a bomber. In each case, careful logic promotes the powerful use of elementary mathematics to produce an elegant solution to a rather complex problem. 38 pp.

N-2218-AF A Comparison of Air-to-Air Detection Ranges of Infrared Search and Track Sets and an Airborne Intercept Radar against Aircraft with Low Radar Cross-Sections (U). L. G. Mundie, J. L. Bono, H. H. Bailey, N. W. Crawford. November 1984. Secret.

(U) To avoid detection, an aircraft must suppress all relevant signatures. Expected infrared systems will detect high-altitude aircraft at great ranges. If high-altitude operation is needed, both the infrared signature and the radar cross-section must be reduced. This study compares infrared and radar detection ranges as a function of such parameters as sensor performance, radar cross-section, altitude, target speed, infrared emissivity of the target, and atmospheric type. Its findings show that, if the radar cross-section of an aircraft is greatly reduced, the infrared signature may dominate the detection process, and that low radar cross-section does not make an aircraft invisible—all signatures must be considered in design decisions for low observables. 37 pp. Ref.

N-2223-AF Space-Based Defense Against Strategic Aircraft (U). R. A. Scheder, A. F. Brewer, R. H. Frick, K. J. Hoffmayer, J. H. Rosen, L. N. Rowell. May 1985. Secret.

(U) The case for space-based elements of a layered defense against ballistic missiles need not rest solely on their cost-effectiveness in destroying ballistic missile delivery systems. With perhaps only minor modification, such weapons may have a potential multi-mission capability. With appropriate surveillance, some classes of space weaponry might be effective against some types of air and ground targets. The authors compare several Strategic Defense Initiative beam and projectile space weapon constellations as they defend against a strategic aircraft attack on the United States about the year 2000. 43 pp. Ref.

N-2227-AF RAND Winter Study on Nonnuclear Strategic Weapons: Executive Summary. C. H. Builder, Y. Ben-Horin, T. A. Brown, R. E. Darilek, G. Dennis, J. A. Dewar, C. Hudson, Jr., C. Krieger, J. Laney, A. A. Platt, R. M. Rosenberg, W. Schrecker, A. J. Vick. December 1984.

Advancing technologies, particularly in micro-electronics and manifested in "smart" munitions, are offering the future prospect of nonnuclear weapons capable of performing

some of the missions now assigned to strategic nuclear forces. That prospect may be advanced by increasingly voiced concerns about the possession or use of the large stockpiles of strategic nuclear weapons. The emergence of nonnuclear strategic weapons (NNSW), perhaps before the turn of the century, could have profound implications for current security concepts and policies. The purpose of the research reported here was to anticipate as many as possible of those implications and, thereby, improve the basis for U.S. Air Force planning. Current concepts for deterrence and for the waging of strategic and theater warfare were reexamined for the potential changes that might occur as a result of the advent of significant NNSW capabilities. Similarly, current policies for security alliances and for the proliferation and control of nuclear arms were reviewed for the stresses or changes that might accompany the emergence of NNSW. While many of the potential changes in security concepts and policies are so complex as to defy judgments about whether NNSW should be welcomed or rejected, there is little doubt that NNSW are emerging and that they will greatly complicate our ideas about how to prevent or wage wars. The salient uncertainties now, however, are technical: How far can NNSW go in posing alternatives to strategic nuclear weapons? 35 pp.

N-2230-AF The State of Western Research on Soviet Military Strategy and Policy. B. S. Lambeth. October 1984.

This Note reviews Western research on Soviet military thought, with special emphasis on Soviet doctrine and its impact on Soviet force planning and behavior. It traces the evolution of the field since the 1950s; examines the ongoing debate over major issues regarding the Soviet military challenge; discusses problems of evidence and interpretation as they apply to Soviet military research; and suggests new directions for the field. It is the overall character of the Soviet "threat," not Soviet doctrine in isolation, that inspires the most heated contention in the current national security debate. Although some of this contention revolves about legitimate differences over the meaning of ambiguous data, it stems for the most part from conflicting a priori assumptions about the Soviet Union. The Note suggests a view of the Soviet challenge that lies between the two conflicting views that dominate public discussion. It also argues that we know as much as we are going to learn from available materials on Soviet military thought and maintains that future research should aim toward broadening our appreciation of how Soviet forces might actually be brought to bear in combat. 65 pp.

N-2241-AF TSAR User's Manual. A Program for Assessing the Effects of Conventional and Chemical Attacks on Sortie Generation: Vol. I, Program Features, Logic, and Interactions. D. E. Emerson, L. H. Wegner. August 1985.

This Note is one of four volumes that collectively describe the latest versions of the TSAR and TSARINA computer models, which were developed at The RAND Corporation to assess the effect of attacks on the sortie generation capabilities of airbases. The Theater Simulation of Airbase Resources (TSAR) model provides an analytic context within which a variety of airbase improvements may be

tested. New passive defenses, new chemical defenses, new maintenance doctrine, improved base repair and recovery capabilities, increased stock levels for parts and equipment, and concepts for improved theater-wide resource management can be examined for their effect on sortie generation. This volume provides a full description of the logic used in the TSAR model, as well as an understanding of interrelations among the many elements of the logic. (See also N-2242, N-2243, N-2244.) 206 pp. Ref.

N-2242-AF TSAR User's Manual. A Program for Assessing the Effects of Conventional and Chemical Attacks on Sortie Generation: Vol. II, Data Input, Program Operations and Redimensioning, and Sample Problem. D. E. Emerson, L. H. Wegner. August 1985.

This Note is one of four volumes that collectively describe the latest versions of the TSAR and TSARINA computer models, which were developed at The RAND Corporation to assess the effect of attacks on the sortie generation capabilities of airbases. The Theater Simulation of Airbase Resources (TSAR) model provides an analytic context within which a variety of airbase improvements may be tested. New passive defenses, new chemical defenses, new maintenance doctrine, improved base repair and recovery capabilities, increased stock levels for parts and equipment, and concepts for improved theater-wide resource management can be examined for their effect on sortie generation. This volume is intended for those persons responsible for preparing input materials and for operating the TSAR simulation program. (See also N-2241, N-2243, N-2244.) 237 pp.

N-2243-AF TSAR User's Manual. A Program for Assessing the Effects of Conventional and Chemical Attacks on Sortie Generation: Vol. III, Variable and Array Definitions and Other Program Aids. D. E. Emerson, L. H. Wegner. August 1985.

This Note is one of four volumes that collectively describe the latest versions of the TSAR and TSARINA computer models, which were developed at The RAND Corporation to assess the effect of attacks on the sortie generation capabilities of airbases. The Theater Simulation of Airbase Resources (TSAR) model provides an analytic context within which a variety of airbase improvements may be tested. New passive defenses, new chemical defenses, new maintenance doctrine, improved base repair and recovery capabilities, increased stock levels for parts and equipment, and concepts for improved theater-wide resource management can be examined for their effect on sortie generation. This volume is intended for those persons interested in modifying and extending the existing program logic or in clarifying apparent errors. (See also N-2241, N-2242, N-2244.) 142 pp.

N-2244-AF TSARINA: A Computer Model for Assessing Conventional and Chemical Attacks on Airbases. D. E. Emerson, L. H. Wegner. August 1985.

This Note describes TSARINA—the latest modification of RAND's Airbase Damage Assessment (AIDA) computer model—which was developed for examining chemical as well as conventional air attacks against complex targets.

This model assesses the chemical deposition and the conventional losses and damage to various categories of resources, including buildings and facilities. TSARINA can be used to assess the losses that would be sustained from a campaign of air attacks on airbases or other complex targets, and to assess the impact of various dispersal or hardening proposals on the expected losses. It can also be used in conjunction with the TSAR simulation model to assess the impact of chemical casualties and disruption as well as conventional airbase damage on sortie generation capabilities, and to evaluate proposals for improving those capabilities at an airbase or set of airbases. This Note includes detailed user instructions as well as a program listing. (See also N-2241, N-2242, and N-2243.) 252 pp. Ref.

N-2246-AF The System and Logic of Supply in the Soviet Union: The Role of the State Committee on Supply (Gossnab) (U). A. J. Alexander. March 1985. Confidential NOFORN WNINTEL.

(U) To increase Western understanding of the possible direction of Soviet economic policy, and the interaction between central economic policy formation and decision-making on the one hand, and major sectoral resource allocation problems on the other, this Note examines the organization and operation of the State Committee on Material-Technical Supply (Gossnab). Gossnab generates product balances, distributes or allocates products from specific producers to consumer organizations, and manages the physical storage and distribution of many products. Defense needs at times must compete with other priority consumers for available supplies. Gossnab responds to political decisions, to organizational incentives and constraints, and to the bounds imposed by the technology of planning and production. 23 pp.

N-2252-AF Cost Implications of Transferring Strategic Airlift C-141s to the Air Reserve Forces. A. A. Barbour. February 1985.

The Military Airlift Command's C-141 fleet presently is operated under an arrangement whereby each squadron is manned by both active duty and reserve personnel on an approximately 55 percent active to 45 percent reservist basis. This Note compares the cost of operating these C-141 squadrons under the present arrangement with the cost of a wholly reservist operation. It was found that when the costs of the present combined operation are calculated with the usual cost factors for C-141 squadrons there appears to be a potential to save one-third of the annual cost per squadron by transferring the C-141s to the Air Reserve Forces (ARF). However, the relatively high cost of the present C-141 operation stems largely from peacetime airlift requirements which would not be reduced by a transfer of C-141s to the ARF. As a result, the potential savings of a transfer become negligible when the cost of providing this peacetime airlift service by other means is added back in. The author emphasizes that when another cargo aircraft is acquired that can adopt the peacetime missions of the C-141s at comparable cost, these side-effects of the C-141 active/ARF comparison will disappear. 49 pp. Ref.

N-2262-AF USAF Defensive and Retaliatory Chemical Warfare Capabilities: A Briefing (U). M. Callero, F. Kozaczka, W. E. Naslund. March 1985. Secret Intelligence Information.

(U) This Note reports results of a study of chemical warfare as it pertains to air operations in the NATO central region. It defines criteria for Soviet decisions to initiate chemical attacks against NATO airbases, describes how such attacks would severely reduce NATO's ability to generate combat sorties, describes how retaliatory chemical attacks would cause equally severe impacts on Soviet sortie generation, surfaces grave weaknesses in USAF capability to conduct retaliatory chemical attacks, and recommends ways to achieve a reliable chemical retaliatory capability and lessen the impact of Soviet chemical attack. 72 pp. Bibliog.

N-2263-AF The Sustainability of the Soviet Strategic Rocket Forces (U). M. D. Mihalka. December 1984. Secret Formerly Restricted Data NOFORN WNINTEL.

(U) This Note reviews the evidence suggesting that the Soviet Union intends to sustain the operations of its Strategic Rocket Forces (SRF) in the face of conventional and nuclear attacks against those forces, and assesses the extent to which it will be likely to do so. The SRF consists of land-based, medium-range, intermediate-range, and intercontinental ballistic missiles. This study is primarily concerned with the ICBMs. 61 pp.

N-2270-AF/RC Performance of a Ground-Based Electromagnetic Gun as an Anti-Satellite Weapon (U). L. N. Rowell, A. F. Brewer, T. B. Garber, R. A. Scheder. April 1985. Secret.

(U) This Note reports on a preliminary analysis of the potential capability of a ground-based electromagnetic (EM) gun for the anti-satellite (ASAT) mission. Because ground-based EM guns have the potential to deliver projectiles into space at high velocities, they offer the prospect of a ground-based antisatellite weapon that could effect control of near-earth space. The authors discuss EM gun accuracy requirements for the ASAT mission, the type and size of EM gun projectiles needed, and specifications for acquisition and tracking, as well as an EM gun engagement model developed in prior studies. Finally, they present hit probability results for an EM gun launching unguided, non-fragmenting projectiles at a large platform in low earth orbit. 35 pp. Ref.

N-2280-AF The Soviet Campaign Against INF: Strategy, Tactics, Means. A. R. Alexiev. February 1985.

Beginning in 1979, the Soviet Union mounted a major effort to prevent the deployment of NATO's INF (intermediate-range nuclear forces), which was scheduled to begin in 1983. The campaign failed to achieve its main objective, but it remains an instructive example of the Soviet political modus operandi and perhaps the best case study of a concerted Soviet effort to manipulate domestic trends in Western countries. This Note attempts to provide some insight into Soviet tactics and operational style. It places the INF issue within the framework of Soviet security concepts, reviews Soviet efforts to influence decisionmaking elites in

West Germany against INF and to exacerbate U.S.-European friction within NATO, and analyzes the methods used by the Soviets in their campaign to co-opt the West German peace movement. The author finds that the campaign waged by the Soviets demonstrated a remarkable organizational and political capability which enabled them and their allies to exploit large numbers of noncommunists in West Germany, and contribute to the growing polarization of West German politics. 44 pp.

N-2283/1-AF Aircraft Airframe Cost Estimating Relationships: All Mission Types. R. W. Hess, H. P. Romanoff. December 1987.

This Note is part of a series that derive a set of equations suitable for estimating the acquisition costs of various types of aircraft airframes in the absence of detailed design and manufacturing information. A single set of equations was selected as being the most representative and applicable to the widest range of estimating situations. For all mission types, the equation set uses empty weight and speed as the basic size-performance variable combination. 131 pp. Ref.

N-2283/2-AF Aircraft Airframe Cost Estimating Relationships: Fighters. R. W. Hess, H. P. Romanoff. December 1987.

This Note is part of a series that derive a set of equations suitable for estimating the acquisition costs of various types of aircraft airframes in the absence of detailed design and manufacturing information. A single set of equations was selected as being the most representative and applicable to the widest range of estimating situations. For fighters, the equation set uses airframe unit weight as the variable. 135 pp. Ref.

N-2283/3-AF Aircraft Airframe Cost Estimating Relationships: Bombers and Transports. R. W. Hess, H. P. Romanoff. December 1987.

This Note is part of a series that derive a set of equations suitable for estimating the acquisition costs of various types of aircraft airframes in the absence of detailed design and manufacturing information. A single set of equations was selected as being the most representative and applicable to the widest range of estimating situations. For bombers and transports, no single acceptable estimating relationship could be identified. Estimates for these aircraft should be developed by analogy or by using the equation set developed for all mission types. 51 pp. Ref.

N-2283/4-AF Aircraft Airframe Cost Estimating Relationships: Attack Aircraft. R. W. Hess, H. P. Romanoff. December 1987.

This Note is part of a series that derive a set of equations suitable for estimating the acquisition costs of various types of aircraft airframes in the absence of detailed design and manufacturing information. A single set of equations was selected as being the most representative and applicable to the widest range of estimating situations. For attack aircraft, no single acceptable estimating relationship could be identified because sample sizes were small and not homogeneous. Estimates for these aircraft should be developed

by analogy or by using the equation set developed for all mission types. 49 pp. Ref.

N-2286-AF B-52G Delivered Standoff Weapons Against Fixed Targets in a Central European War (U). J. A. Dewar. August 1985. Secret NOFORN WNINTEL.

(U) This Note discusses work done on conventional uses of the B-52 bomber for theater support. The exploratory nature of the study required that several restrictive assumptions be made. A key assumption was that the B-52s would stand off sufficiently from the theater threats that their attrition would be negligible. Consideration of theater threats to the B-52s and of plausible targets of interest led to two basic conclusions: (1) standing off 100 nautical miles from the inter-German border would minimize attrition through the 1990s, and (2) a range of 500 nautical miles would be needed for a standoff cruise missile to attack a significant percentage of the plausible theater targets from 100 nautical miles standoff. The Note also analyzes simulations of two possible missions: (1) attack unsheltered aircraft on 22 Pact Dispersed Operating Bases, and (2) attack runways on 20 Main Operating Bases to pin in (sheltered) air defense aircraft. The study suggests that a force of B-52s with stand-off weapons could be a useful force addition in a theater conflict. 37 pp. Ref.

N-2294-AF Soviet Reactions to NATO's Emerging Technologies. M. J. Sterling. August 1985.

This Note analyzes Soviet reactions to and concern over NATO's use of deep-look reconnaissance sensors, automated command and control, and highly accurate conventional munitions made possible by "emerging technologies" (ET). It briefly describes the emerging technologies and their application to deep attack concepts, and it examines Soviet commentary on the systems and employment concepts being discussed in the West, Soviet views of the utility of such systems, and their impact on Soviet forces and tactics. It considers Soviet response options in the near and medium terms, and their implications for the West. Among its conclusions are the following: (1) the Soviets are more concerned with the long-range implications of ET rather than with any particular weapon; (2) the West should take care not to squander its lead in this area of weapons development; (3) any reconnaissance, command-control-communication, or attack systems the West develops must be resistant to Soviet countermeasures; and (4) because of the implications for future arms negotiations, future ET weapons should be distinguished from their nuclear counterparts, in terms of both their physical appearance and flight profiles. 26 pp. Bibliog.

N-2301-AF Assessing the Benefits and Costs of Motion for C-17 Flight Simulators: Technical Appendixes. J. R. Gebman, W. L. Stanley, A. A. Barbour, R. T. Berg, J. L. Birkler, M. G. Chaloupka, B. F. Goeller, L. M. Jamison, R. J. Kaplan, T. F. Kirkwood, C. L. Batten. June 1986.

This document provides technical support for R-3276. Appendixes describe (1) experiments to determine the value of motion in training simulators; (2) aircraft features that will influence the motion of the C-17; (3) possible effects on motion cues of the C-17's stability and control augmenta-

tion system; (4) the fidelity of different simulator motion cueing alternatives; (5) a suggested methodology for assessing the training capability of simulators; (6) the effects of simulator motion on simulator training capability, safety, and avoidance of simulator sickness; and (7) the costs of providing motion in simulators. 200 pp. Bibliog.

N-2302-AF/RC Concepts, Problems, and Opportunities for Use of Annihilation Energy: An Annotated Briefing on Near-Term RDT&E to Assess Feasibility. B. W. Augenstein. June 1985.

This Note discusses several issues inherent in exploiting the energy released when matter and antimatter annihilate. It reviews some of the fundamental difficulties in producing antimatter and means for storing it. If these difficulties have satisfactory solutions, a number of applications for antimatter are likely to emerge. The Note emphasizes the fundamental importance of the very large classes of interesting research efforts underlying applications goals, and the anticipated rapid growth of science needs for antimatter at low energies. The author suggests a near-term program to resolve the current uncertainties of suitable production and storage technologies, so that basic feasibility of applications of antimatter can be decided, and decisions on whether to undertake expanded production with appropriate storage can be objectively made. 67 pp. Bibliog.

N-2312-AF Conventional Airbase Attack and Defense Technologies (U). M. B. Schaffer, R. M. Smith. December 1987. Secret NOFORN WNINTEL.

(U) This Note analyzes the technological competition between conventional airbase attack weapons and airbase defense techniques in order to identify viable defense approaches. The authors consider the performance limits of several generic munitions, discuss the prospects for Warsaw Pact airbase attack armament, review the objectives for airbase defense and the degree to which the present program is achieving them, and evaluate the extent to which the NATO community has exploited technological opportunities as they have arisen. 145 pp. Ref.

N-2314-AF Airbase Ground Defense Europe: British, West German, Canadian, and French (U). G. K. Tanham. May 1986. Secret NOFORN.

(U) This Note, part of a larger study of airbase survivability, is primarily a trip report covering visits to a few selected British, French, German, and Canadian airbases, all located in Western Europe. This survey concentrated on air force defensive measures against ground attack and infiltration. 31 pp.

N-2327-AF Laser Damage to Hardened and Rolling Missiles (U). J. H. Rosen, A. R. Wazzan, R. A. Eden. October 1985. Secret.

(U) The effectiveness of a space-based laser defense system depends strongly on how long it takes the laser to kill a thrusting ballistic missile. The shorter this kill time, the greater will be the number of kills made by the laser during the boost phase of a salvo launch. This Note addresses three of the many factors that can strongly influence kill

times: kill mode, surface thermal hardness, and shape of the area that must be damaged. Although missile hardness is determined by many factors, this Note concentrates on two: (1) coating the booster surface with an ablator, and (2) rolling the booster under the beam. In successive sections, the Note evaluates the viability of the thermal soak kill mode, examines the possibility of achieving a kill by lasing along an arc or band rather than over a spot, calculates kill times required by band vs. spot targeting, and assesses how these kill times could be amplified by the countermeasure of rolling the booster under the beam. An appendix develops equations for computing kill time as a function of the roll rate of the missile. 71 pp. Ref.

N-2335-AF Logistics Support for a Staggered Tanker Launch. N. Y. Moore, T. F. Lippiatt. June 1987.

This Note is part of a project to evaluate the benefits of selectively delaying the penetration of the bomber force. If the Strategic Air Command were to stagger the launch of its tankers, it could further delay bomber penetration without increasing the size of the tanker force. Because additional landings and takeoffs would be required for some tankers, the concept has implications for logistics and aircraft availability. This study assesses the benefits of providing manpower and spares support to the staggered tankers, and it outlines the planning necessary to assure the appropriate mix and availability of maintenance resources. The findings indicate that the staggered tanker operational concept benefits substantially from the addition of a mobile maintenance turnaround team and selected spares. 29 pp. Ref.

N-2339-AF Twelve Case Studies of Terminations and Divestitures by Business Firms. S. J. Bodilly. April 1986.

To aid the Air Force in planning for potential budget cuts dictated by the Gramm-Rudman-Hollings Act, this Note considers case studies of twelve firms that have terminated or divested major activities. The study's findings suggest the following conclusions: (1) large organizations have difficulty terminating or divesting major activities; (2) a decision to terminate a major activity is usually made in conjunction with a decision to continue or initiate another activity, tying it to broad questions of corporate strategy; (3) successful corporations viewed termination in the larger context of corporate strategy, while often reformulating that strategy; (4) the strategy provided a context for decisions, not a plan; (5) top management's leadership skills were crucial in initiating, encouraging, and supporting the corporate strategy changes; and (6) termination efforts required the use of nonroutine procedures outside the established budgeting and planning processes. (See also R-3303.) 34 pp. Bibliog.

N-2344-AF A Hybrid (Radar/Laser Radar) Sensor System for Use with a Ground-Based Electromagnetic Gun in the Attack of Satellites (U). L. G. Mundie. March 1986. Secret Intelligence Information.

(U) This Note presents the results of a study devoted to the conceptualization of a microwave radar/laser radar system which will provide the tracking and ranging information that a ground-based electromagnetic gun would require in

order to attack a satellite. The system must first acquire the target satellite and then provide tracking and ranging information on both the satellite and the projectile. The system must also provide information that will permit command guidance of the projectile, if needed, and command detonation at the optimum time. 41 pp. Ref.

N-2348-1-AF Key Issues for the Strategic Offensive Force Reduction Portion of the Nuclear and Space Talks in Geneva. E. L. Warner, G. A. Kent, R. J. DeValk. December 1985.

This Note discusses approaches for the limitation and reduction of U.S. and Soviet strategic attack forces. It identifies three national security objectives that the United States and, arguably, the Soviet Union seek to obtain through a combination of strategic nuclear force deployments, arms control, and diplomacy. Those objectives are credible deterrence, strategic/crisis stability, and essential equivalence. It defines three measures that can be controlled to constrain the destructive capacity of intercontinental strategic attack forces: the amount of ballistic missile throwweight; the number of ballistic missile reentry vehicles; and the number of bomber-carried weapons, a value that can most reasonably be estimated by linking it to the gross takeoff weight of the strategic bombers on both sides. It also considers a weighted-measure approach that yields a smaller initial difference between U.S. and Soviet ballistic missile forces than does the pure throwweight approach, thus providing better prospects for successful compromise in negotiation. The Note reviews several recent proposals for U.S.-Soviet strategic arms reductions and concludes that the United States cannot reasonably expect to gain significant cuts in Soviet ballistic missile capabilities without being prepared to accept substantial constraints on the growth of the U.S. bomber force's weapon-carrying potential. 36 pp.

N-2366-AF A Perspective on the USAFE Collocated Operating Base System. D. E. Lewis, B. W. Don, R. M. Paulson, W. H. Ware. July 1986.

This Note documents the results of an evaluation of selected management issues associated with the development of the collocated operating base (COB) program in NATO. The COB concept was developed in response to requirements for bedding down the large number of aircraft that the U.S. Air Force will send to Europe to support current contingency plans for augmenting USAFE (U.S. Air Forces in Europe) based in the theater. The research was designed to (1) assess the current status of the COB system of airbases in Europe; (2) evaluate the capability of the COBs, especially their ability to generate and sustain wartime sorties; (3) identify means of enhancing the combat contribution of the COBs; and (4) identify actions that could improve the wartime readiness of COB-related resources. The authors suggest that USAFE staff develop two general policy areas to ensure that the COBs provide the planned defense posture: (1) a concerted program to increase peacetime emphasis on designing and implementing the COB system and (2) specific programs to evaluate and test the warfighting capabilities of COB-based augmented air forces. 41 pp.

N-2372-AF/RC Damage Assessment for High-Power Microwave Weapon Systems (U). E. Bedrosian. November 1985. Secret.

(U) This Note presents the results of an investigation of remote damage assessment techniques suitable for use with hypothetical high-power microwave (HPM) weapon systems. Because HPM devices employ directed electromagnetic energy as the damage mechanism rather than kinetic energy, recognizing and assessing kills may be difficult. The electronic damage effects caused by such a weapon are discussed, to suggest useful ways in which they could manifest themselves. Then, diagnostics to assess the damage are developed. The study considers several systems aspects of an HPM weapon and their components, and firing doctrines are devised to illustrate how the peculiar characteristics of an HPM weapon could be exploited in battle. 34 pp. Ref.

N-2382-AF Alternative Landing and Takeoff Sites for Strategic Aircraft: A Brief Review (U). C.J. Bowie. July 1986. Secret.

(U) This Note is part of an examination of concepts of operations that might be employed by the modernized Strategic Air Command (SAC) bomber and tanker force in an extended period of hostilities. It considers the potential offered by alternative landing and takeoff sites to improve the survivability of SAC bombers and tankers during an extended post-exchange period. The Note examines the evolution of the SAC basing structure and surveys past work on alternative sites within the continental United States to complement current research on alternative operational concepts for the bomber and tanker force. 32 pp. Bibliog.

N-2388-AF Some Concepts for an Airborne High-Power Microwave Weapon System (U). H.H. Bailey. February 1988. Secret.

(U) This Note explores four concepts for implementing a high-power microwave weapon system, which is potentially useful in a variety of defense suppression and self-defense roles. Despite major uncertainties, the findings suggest that the possibility of achieving very high fire-power is sufficiently encouraging to justify further development of certain critical components. 51 pp. Ref.

N-2400-AF The Soviet Union and the Socialist and Social Democratic Parties of Western Europe. J. VanOudenaren. February 1986.

The Socialist, Social Democratic, and Labor parties of Western Europe have always presented special opportunities and difficulties for Soviet foreign policy. From the Soviet perspective, these parties are important for three reasons, all of which must be considered in making policy toward them and toward Western Europe in general: (1) most of these parties are actual or prospective governing parties; (2) they represent that part of the West European public that Soviet analysts regard as "realistic" in its attitudes toward the Soviet Union and "progressive" on other issues; and (3) the parties of the non-Communist left, at least according to Soviet ideology, are potential partners in the revolutionary struggle. This Note examines Soviet policy toward the non-Communist left in Europe in light of the three roles

these parties play in Soviet eyes. It reviews Soviet strategy toward the non-Communist left as it has evolved in recent years, analyzes trends within the parties of the non-Communist left and the way in which they are responding to various Soviet initiatives, and considers the implications for the Atlantic alliance of these trends and of Soviet efforts to exploit them. 49 pp.

N-2409-AF Tanker Splitting Across the SIOP Bomber Force (U). P.B. Rehms, N.S. Cardell. January 1988. Secret.

(U) A Strategic Air Command tanker usually offloads its fuel to only a single heavy bomber and, subject to several operational constraints, does so in ways intended to maximize the bomber's range capability. This Note investigates an alternative operating procedure: routine splitting or sharing of a tanker's fuel among two or more heavy bombers. It emphasizes the possibility that such tanker splitting on a force-wide or massive scale could substantially increase the effective size of the tanker force by increasing the average bomber range capability. 63 pp. Ref.

N-2413-AF/A On the Adapting of Political-Military Games for Various Purposes. W.M. Jones. March 1986.

Political-military gaming has long been used to study international confrontations and conflicts, to provide a means of interchange for groups of scholars and operators interested in the interplay of political and military factors in area confrontations, and to educate and train people who may actually become involved in dealing with such confrontations. The basic structure and procedures of this type of gaming are subject to considerable variation. This Note attempts to describe these structures and processes, and is designed as a primer on the subject. 21 pp.

N-2416-AF Process and Problems in Developing NATO Tactical Air Doctrine. D.J. Stein, K.A. Nolan, R.L. Perry. June 1988.

Understanding the interests and tactics of our allies is important to improving cooperation with the Tactical Air Working Party of NATO. This Note examines the administrative processes and competing influences involved in negotiating statements of NATO's tactical air doctrine, including the joint process for developing U.S. positions on NATO air doctrine and the combined process by which national proposals eventually emerge as formal NATO doctrine. The Note reviews the air power interests of Great Britain and West Germany and their influence on the development of NATO air doctrine. The authors make tentative suggestions for enhancing the U.S. position in negotiations over allied air power issues. 34 pp. Bibliog.

N-2421-AF Descent Times for Strategic Hypervelocity Impactors: I. A Preliminary Computational Study (U). M.L. Juncosa, F.W. Murray. June 1987. Secret.

(U) Computations show the advantages of additional velocity increments (ΔV s) provided at deorbit. Descent times are computed for varying ΔV s and varying deorbit points from apogee to perigee in a satellite's highly eccentric elliptic orbit. Some results show strategic potential.

Supplementary computations give the weight penalty, measured as the ratio of the mass of propellant to the mass of the payload as a function of *delta V* required. Derivations of the equations used in the study are given in an appendix. (See also N-2422-AF.) 105 pp. Ref.

N-2422-AF Descent Times for Strategic Hypervelocity Impactors: II. Numerical Analysis and Description of the Code (U). M.L. Juncosa, F.W. Murray. June 1987. Secret.

(U) A companion Note, N-2421-AF, presents computations showing that additional velocity increments (*delta Vs*) provided at deorbit offer possible strategic potential. It also gives the derivation of the equations. This Note provides numerical analysis to show how the equations can be solved in practice and describes FORTRAN codes for solving them on a personal computer. Code listings are given in the appendix. 35 pp. Ref.

N-2431-AF Enhancing Conventional Defense by Improving NATO Tactical Air (U). C.T. Kelley, Jr. August 1986. Secret Intelligence Information NATO Releasable.

(U) This Note contains the charts and text of a summary briefing on investigations of issues related to improving NATO tactical air capabilities in the European theater. These issues include ways of enhancing the survivability of tactical air, methods for defeating the emerging Warsaw Pact tactical ballistic missile threat, employment of NATO tactical air in ways that help achieve theater objectives, and contributions of the proposed Counterair-90 and other force improvement programs. 75 pp.

N-2443-AF Tactical Dispersal of Fighter Aircraft: Risk, Uncertainty, and Policy Recommendations. J. Halliday. February 1987.

This Note examines U.S. Air Force policy on the basing of tactical fighter aircraft. Specifically, it addresses the risks of losses to both aircraft and sorties that are implicitly accepted by commanders and policymakers when they base fighters within range of potential attackers. It also deals with one potential alternative to the current static basing mode—tactical dispersal—and with the organizational impediments to it. The author applies the concepts of risk and uncertainty to plausible attack scenarios for main operating bases and dispersed sites, and he discusses policy issues that must be addressed if high sortie rates are to be sustained during the early days of a conflict. He recommends that a program be designed to empirically test the assumptions used in the models for evaluating basing policy. 73 pp. Bibliog.

N-2457-AF "Typical Weather" Months in the Past (1973-1983) in Central Europe. R.E. Huschke. March 1988.

This Note documents historical periods of Central European weather that reliably typify average weather conditions for any chosen season. It also identifies "worst case" and "best case" weather periods that can be used to establish "weather bounds" on results of air-land battle simulations. 28 pp.

N-2472-AF The Soviet Population Policy Debate: Actors and Issues. M. Feshbach. December 1986.

This Note examines the Soviet Union's successful campaign since the early 1960s to revive demography as a science and as a foundation for population policies. It traces the connections between expert discussions and policy decisions, and describes the tactics Soviet scholars use to direct attention toward complex and sensitive issues. The source materials are Soviet monographs, journals, and newspapers, as well as internal small-circulation documents and information the author acquired on personal visits. The findings suggest that the channels, including personal ties, by which individual or collective recommendations reach the levels where new policies are authorized remain obscure, but there is no doubt that demographers in the Soviet Union have been heard. 86 pp. Ref.

N-2478-AF Possible Soviet Responses to the Strategic Defense Initiative: A Functionally Organized Taxonomy. K.N. Lewis. July 1986.

In the wake of the Strategic Defense Initiative (SDI), much effort has been devoted to estimating potential Soviet responses to it. There is general agreement that the Soviet response will (1) consist of attempts to stop, circumvent, emulate, and neutralize the SDI; (2) include political, military, and strategic efforts; and (3) vary over time, depending on several factors. Setting aside Soviet technological options, this Note considers various factors that might interest or influence senior Soviet decisionmakers as they consider a range of programmatic, strategic, and political options for responding to the SDI. Its goal is to identify generic categories of Soviet response options rather than the specific forms those options may take. 55 pp.

N-2479-AF Warranties for Weapons: Theory and Initial Assessment. J.P. Stucker, G.K. Smith. April 1987.

Warranties have been selectively applied to weapon systems acquisition over several decades. However, in 1983 Congress passed the first law requiring that military contractors provide warranties on all major weapons sold to the Services. Such blanket application raises issues both of tailoring warranties to the wide range of weapons and acquisition environments and of proper implementation policy and procedural guidelines. This study concludes that warranties can have a positive effect on selected acquisition programs. Analysis of pre-law warranties suggests that factors contributing to warranty success include: specific, easily measurable objectives; explicit contractor incentives and remedies; explicit government duties; and reasonable prices and expectations. An initial survey of post-law warranties, however, reveals that many warranties do not appear to adequately detail either their objectives or the remedies to be applied if those objectives are not met. 90 pp. Ref.

N-2482-AF The Soviet Union and the Strategic Defense Initiative: Preliminary Findings and Impressions. B.S. Lambeth. June 1986.

This Note provides a background against which to evaluate possible Soviet alternatives for dealing with the Strategic Defense Initiative (SDI) in the decade ahead. Without

speculating about what the Soviets will ultimately do in response to SDI, the Note (1) examines Moscow's statements on SDI to date, (2) reviews the highlights of Soviet doctrine and programs related to strategic defense, (3) considers the real concerns that may underlie the Kremlin's public posturing on SDI, and (4) outlines the key political and strategic factors that will constrain the Soviets' eventual response. The author suggests that, assuming SDI does lead to a deployable U.S. ballistic missile defense, the Soviets will be driven to counter that threat within the limits of their economic and technical resources. Forecasting the technical details of their response at this time, however, is complicated by uncertainty not only about Soviet concerns, motivations, and intentions, but also about what the United States will eventually do with SDI. 55 pp.

N-2490-AF The Revolutionary Left and Terrorist Violence in Chile. W. F. Sater. June 1986.

To provide an understanding of the current political situation in Chile, this Note reviews events leading up to the 1973 coup that established a military government there. In particular, it discusses the Movimiento de la Izquierda Revolucionaria (MIR), which has become the principal opposition to the current government of Augusto Pinochet. The author reviews MIR's operations, membership, funding, and relations with other political elements in Chilean society. He concludes that a political solution to the troubles in Chile does not presently appear possible since Pinochet will not deal with the relatively moderate political elements in Chile. The situation is polarized and the prospects for terrorist violence are increasing. 19 pp.

N-2497-AF Factors Affecting the Military Environment of North Norway: Its History, International Relations, Physical Characteristics, and Balance of Military Forces. J. G. Terry. January 1988.

Northern Europe has been remarkably stable since the end of World War II. This report discusses how certain factors—the history, international relations, physical characteristics, and the present balance of military forces of Northern Europe—have shaped the military environment of North Norway to make it unique among the theaters of military operations in the world. (See also R-3439-AF.) 61 pp. Bibliog.

N-2499-AF The Cost and Performance Implications of Reliability Improvements in the F-16A/B Aircraft. J. B. Abell, T. F. Kirkwood, R. L. Petruschell, G. K. Smith. March 1988.

This Note suggests the magnitude of the effects of policies and strategies to enhance reliability of Air Force aircraft weapon systems. Using the F-16A/B fighter aircraft program as a case study, the authors found that the benefits of improved reliability include (1) a reduction in base-level maintenance manpower requirements, (2) increased capability to generate sorties, (3) lowered costs for procurement and repair of engines and spare parts, and (4) reductions in the resources (both equipment and manpower) required to deploy a combat unit to an overseas site. 77 pp. Ref.

N-2514-AF An Analysis of AMRAAM's Operational Utility (U). C. T. Kelley, Jr., S. B. Coleman. September 1986. Secret Intelligence Information NATO Releasable.

(U) This Note, derived largely from a briefing presented to the commander of the Tactical Air Command in March 1985, describes the results of excursions conducted to show the effects of AMRAAM (advanced medium-range air-to-air missile) on theater campaign results. The scope of the research was limited to understanding how air and ground campaign results would be affected if NATO used AMRAAM and if the missile operated at its full projected capability. The study did not investigate either the means for achieving beyond-visual-range identification or the likelihood that AMRAAM would meet its cost and performance goals. 27 pp.

N-2526-AF A Calculus of First-Strike Stability (A Criterion for Evaluating Strategic Forces). G. A. Kent, R. J. DeValck, D. E. Thaler. June 1988.

For analyzing the merits of alternative strategic nuclear force postures, first-strike stability is a more relevant and demanding criterion than deterrence. First-strike stability exists if neither superpower perceives the other as motivated to strike first in a crisis. This Note describes an approach for evaluating the first-strike stability (or instability) of various postures of superpower strategic offensive forces. The study uses a calculus of the cost of striking first compared with the potential cost of waiting and risking an enemy first strike. The analysis suggests that the current postures of U.S. and Soviet strategic offensive forces do not demonstrate any undue degree of first-strike instability. However, merely reducing the level of U.S. and Soviet offensive forces does little to enhance stability and may actually increase first-strike instability because the types and posture of forces deployed have a greater effect on stability than do their overall numbers. To maintain stability, reductions in offensive weapons should be coupled with improved basing modes. 39 pp.

N-2549-AF Using the Air Force Maintenance Data Collection System Data To Identify Candidates for Improvement in Reliability and Maintainability. R. L. Petruschell, G. K. Smith, T. F. Kirkwood. March 1987.

This Note describes a preliminary and limited set of measures using data from the Air Force Maintenance Data Collection System (MDC) to identify likely candidates for reliability and maintainability (R&M) improvement. The method's usefulness depends on the user's having better than average knowledge of the MDC and of base-level maintenance. The MDC is a large, complex, and rich data system. Its magnitude alone is forbidding. The two-step method described shows how to distill these data, prepare useful metrics, and present these data in useful ways to R&M decisionmakers. Site investigations and interviews should be conducted to check the reasons for any high maintenance activity and to understand variability among bases before any R&M improvement program is instituted on a particular system or component. 82 pp.

N-2551-AF New Weather Sensing and Forecasting Capabilities for Ground-to-Space Operations. C. Schutz, F. W. Murray. February 1987.

Certain weather variables exercise an important control over space operations, either by making a launch infeasible or by adversely affecting the space vehicle and its trajectory. Climatological studies and standard National Weather Service observations show that the normal range of variability due to location and season, even from day to day, precludes the forecasting of these variables sufficiently accurately for precise trajectory control. Several new systems are now becoming available for measuring wind and density (or providing the variables from which density can be computed) continuously and automatically: VAS, PROFILER, WINDSAT, and the next generation of weather satellites. Together, these systems offer the promise of continuous real-time monitoring of winds and air density throughout the part of the atmosphere that exercises the greatest influence on space operations. 40 pp. Ref.

N-2567-AF Key Personnel and Organizations of the Soviet Military High Command. E. L. Warner, J. J. Bonan, E. F. Packman. April 1987.

This Note describes the organizational arrangements, including the wartime chain of command, and policymaking relationships for the direction of defense policy at the highest levels of the Soviet system. It also provides a history of the occupants of senior command positions in the Ministry of Defense over the past 10 to 20 years. This information is displayed in various forms, and the military commands that have served as stepping-stones to higher responsibility in the Soviet high command are identified. The Note provides information on organizational and personnel changes through February 1987. 75 pp.

N-2579-AF Survivability Issues and USAFE Policy. B. W. Don, D. E. Lewis, R. M. Paulson, W. H. Ware. May 1988.

This Note reports on the relationship between command policy and survivability within the U.S. Air Forces Europe (USAFE). The study examined major initiatives that the USAFE command is currently implementing or planning to implement and found that survivability must be considered in each one. A balanced mix of the following measures is necessary: active defense, passive defense, damage control, robustness in system design, and recovery of mission capability. The authors recommend several policy actions: strengthen the guidance and enforce it, provide a cross-functional emphasis, use a decision process that specifically includes survivability, and capitalize on individual initiative. 41 pp.

N-2596-AF Soviet-Warsaw Pact Western Theater of Military Operations: Organization and Missions. M. Sadykiewicz. August 1987.

This Note examines the organization and apparent missions of the Soviet-Warsaw Pact forces operating under the high command of the western theater of military operations (TVD), the largest and most important peacetime concentration of military power in the history of Europe. The re-

search is based largely on the author's extensive experience as an officer in the Soviet and Polish armies from 1941 to 1967 and on more recent military literature from the Soviet Union, other Warsaw Pact countries, and the West. Part One analyzes the strategic role that Soviet-Warsaw Pact forces in the western TVD might play during the initial period of a conventional war in Europe. Part Two investigates Soviet concepts of operations for theater conventional warfare. Scenarios depicting the movements and activities of four representative Soviet divisions illustrate the force and command structure and concepts of operations that would likely guide the employment of Warsaw Pact forces in the opening five days of a conventional war in the critical NATO central region. 174 pp. Ref.

N-2602-AF Endurance of a Soviet Forward Air Defense in the Northern Regions (U). J. T. Quinlivan, E. N. Best, C. N. Johnson. August 1987. Secret NOFORN WNINTEL.

(U) This Note documents an analysis of the intrawar endurance of Soviet forward air defenses in the Northern polar region. It examines the vulnerability of alternative forward defenses to suppression attacks. The alternative defenses cover several operational concepts and mixes of forces, with and without tanker support. 65 pp. Ref.

N-2604-AF Unintended Effects of the New Military Retirement System. R. Y. Arguden. May 1987.

In June 1986, the Military Retirement Reform Act was signed into law with the intention of saving \$2.9 billion in the 1986 accrual funding of the military retirement budget. This Note analyzes the potential effects of the new policy on personnel retention. Previous analyses conducted by the government to assess the effects of this new retirement policy have been based on the annualized cost of leaving (ACOL) model. Here, a new methodology, the dynamic retention model, is used to demonstrate that the ACOL methodology suffers considerable biases and that the potential effects of the new policy on retention are likely to be much greater than the ACOL model predicts. For instance, personnel losses may be larger than expected and the retention of higher quality personnel is likely to be reduced more than the retention of other personnel. The negative retention effects will probably be observed sooner than the intended cost savings. 19 pp. Ref.

N-2620-AF Operating Characteristics of TAC Aircraft Electronic Combat Self-Protection Systems (U). A. L. Hiebert, W. Sollfrey. October 1988. Secret NOFORN.

(U) This Note, part of a study of the effectiveness of electronic combat (EC) in the NATO theater of operations, describes U.S. Air Force tactical aircraft EC self-protection systems. It compiles electronic and operating characteristics on current and projected warning receivers, jamming systems, expendables (chaff and flares), and destructive systems (antiradiation missiles). The authors discuss the various functions and capabilities of each piece of equipment. 297 pp. Ref.

N-2629/1-AF ALEC: A Model for Analyzing the Cost-Effectiveness of Air Force Enlisted Personnel Policies (Theory and Results). C. P. Rydell. August 1987.

The Aggregate Lifecycle Effectiveness and Cost (ALEC) model enables managers of Air Force enlisted personnel to compare the cost effectiveness of alternative management actions for a part of the force selected for analysis. Example actions are limits on the numbers of various types of enlistments, reenlistment bonuses designed to increase the number of persons making the Air Force a career, retraining programs that transfer personnel from one specialty to another, and the early-release program. This volume gives the theory and behavioral relationships used to build the model and gives cost-effectiveness results. (See also N-2629/2; microcomputer disk available.) 122 pp. Ref.

N-2629/2-AF ALEC: A Model for Analyzing the Cost-Effectiveness of Air Force Enlisted Personnel Policies (Documentation and User's Guide). C. P. Rydell. August 1987.

The Aggregate Lifecycle Effectiveness and Cost (ALEC) model enables managers of Air Force enlisted personnel to compare the cost effectiveness of alternative management actions for a part of the force selected for analysis. Example actions are limits on the numbers of various types of enlistments, reenlistment bonuses designed to increase the number of persons making the Air Force a career, retraining programs that transfer personnel from one specialty to another, and the early-release program. This volume presents the microcomputer model that estimates the cost effectiveness of management actions for a given part of the enlisted force. Model users can evaluate complex combinations of actions and examine specific parts of the enlisted force. (See also N-2629/1; microcomputer disk available.) 133 pp.

N-2661-AF The NATO Alert System: Implications for U.S. Theater Reinforcement (U). S. M. Holroyd. June 1988. Secret NATO Classified Information.

(U) This Note describes the NATO alert process and analyzes where and how delays might occur that could affect Alliance, particularly U.S., mobilization efforts. It examines how the NATO alert process is intended to guide Alliance-wide readiness efforts. It also recognizes that the alert process could trigger the implementation of bilateral agreements and that implementation could also be done outside of the alert process. 37 pp. Bibliog.

N-2662-AF SDI and the Soviet Defense Burden. G. G. Hildebrandt. December 1988.

The Soviets' response to the Strategic Defense Initiative (SDI) must be understood within the context of their deteriorating economic situation and need to modernize their economy. This Note evaluates the defense burden to the Soviets of both an offsetting and an emulation response to the U.S. SDI effort. The analysis is conducted within the context of General Secretary Gorbachev's modernization program, which is designed to increase the productivity of economic resources. The analysis suggests that the Soviets can partially offset a U.S. SDI effort with a ruble expendi-

ture that is a small percentage of current defense spending. Although the Soviets may regard such a response as unsatisfactory, it is important to consider the striking contrast compared with the burden of an emulation response. The author hypothesizes, therefore, that the Soviets will choose not to directly emulate the U.S. SDI activities, at least until they have modernized their technical-economic base. 35 pp.

N-2688-AF Middle-Term Disaggregate Loss Model Test and Evaluation: Description Results. A. F. Abrahamse. July 1988.

This Note describes the testing and evaluation of a set of equations developed for use in the Air Force's Enlisted Force Management System. The equations predict annual airman loss and reenlistment rates by Air Force Specialty Code. Predictions from the loss models are compared to actual loss rates and to loss rates estimated by the model currently being used by the Air Force. 91 pp. Ref.

N-2697-AF Conventional Arms Control Revisited: Objectives in the New Phase. J. A. Thomson, N. C. Gantz. December 1987.

This Note examines the relationship between conventional defense and arms control planning and assesses the conditions under which arms control can help NATO meet its conventional defense requirements. It first defines a defense objective for NATO, then assesses the balance relative to that objective, and, finally, defines the requirements to fill the gap. The Note concludes that (1) arms control alone cannot correct the conventional force imbalance in Europe; (2) defense requirements can be moderated through arms control, but only if the reductions are highly asymmetric and large; and (3) NATO should seek to reduce the offensive capabilities of the Warsaw Pact forces through reductions of tanks and artillery. 17 pp.

N-2727-AF RJARS: RAND's Version of the Jamming Aircraft and Radar Simulation. W. Sollfrey. December 1988.

RJARS (RAND's version of the Jamming Aircraft and Radar Simulation) is a many-on-many computer simulation involving aircraft, radars, jamming systems, offensive and defensive missiles, and a command-control-communications system for the defense. RJARS treats sortie operations and evaluates jamming effectiveness and mission attrition at a level of detail that includes reasonable refinements of equipment operation without excessive calculational complexity. This Note describes RJARS and its sequence of operations, shows how to prepare input files and operate RJARS, gives programming details, and provides a glossary of the approximately 750 variables used in RJARS. The PL-1 source code is included. 185 pp. Ref.

N-2735-AF USAFE Policy Options in the Face of European Reductions: A Historical Perspective (U). C. J. Bowie. August 1988. Secret NOFORN.

(U) The evolving force posture of U.S. Air Forces Europe (USAFE) has been the result of a complex interplay of external factors. Perhaps the most important of these have

been the changing face of NATO strategy and the continuing demands of the U.S. government to reduce expenditures on overseas military forces. Forces built to support a strategy of massive retaliation were forced to reconfigure to deal with the new demands of flexible response while responding to increasing budgetary and manpower constraints. Fulfilling the needs of NATO strategy in the face of continuing resource constraints has dominated much of USAFE's history in the era of flexible response. This Note attempts to provide a historical context for considering reductions of in-theater forces. 43 pp. Bibliog.

N-2747-AF An Enlisted Force Management System Model To Predict the Effects of Bonus Decisions. G. M. Carter, D. L. Skoller, S. E. Perrin, C. S. Sakai. July 1988.

The RAND Corporation is helping to design an Enlisted Force Management System (EFMS) for the Air Force. This Note describes the design, specification, and prototype implementation of a module in the EFMS that will help skills managers make bonus decisions. That module, which is called the Bonus Effects Model, will enable skills managers to evaluate the effect of alternative bonus plans on projected bonus expenditures and on manpower imbalances in individual specialties. It provides estimates by planning year of bonus expenditures, reenlistments, and inventory by year of service; and it predicts how close both reenlistments and inventory will be to desired targets. 101 pp. Ref.

N-2763-AF RAND Workshop on Antiproton Science and Technology, October 6-9, 1987: Annotated Executive Summary. B. W. Augenstein. October 1988.

This Note describes a conference held in October 1987 to review the critical issues surrounding the establishment of a comprehensive U.S. antiproton research program and to help formulate its research goals. The conference was organized around three major themes: (1) basic machine,

facility, and scale-up review—antiproton production and collection; (2) a basic physics program for a low-energy antiproton source in North America; and (3) near-term and precursor applications using an initial low-energy antiproton source. Among the major conclusions were the following: The United States can construct an intense source of low-energy antiprotons in three to four years, and develop portable antiproton storage devices (rings and ion traps). A dozen classes of key low-energy antiproton experiments can be conducted on questions ranging from charge parity violation to condensed matter. A number of near-term important applications are possible using the source and portable storage devices. 27 pp.

N-2769-AF Soviet Concepts and Capabilities for Limited Nuclear War: What We Know and How We Know It. E. L. Warner. February 1989.

This Note analyzes the evolution of Soviet concepts of and capabilities for limited nuclear war, Western assessments of these concepts and capabilities, and the basis on which the assessments were made. It covers the period from 1954, when the Soviets first began to adapt their military strategy to the nuclear age, to the present. Soviet doctrinal commentary indicates an interest in limiting nuclear use for various military and political reasons; yet the Soviets reject the idea that nuclear war could be fought in a highly limited manner. In addition, their operational doctrine retains a strong preemptive predisposition, particularly with regard to war in Europe, where they are determined to be the first to use nuclear weapons with a potentially decisive military effect. However, given their nuclear strike capabilities and command-and-control arrangements that provide tight control over initial nuclear release, the Soviets could employ their nuclear attack forces with a wide range of self-imposed constraints. 49 pp.

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U ☐ R-1889-AF	U ☐ R-2184/1-AF	S ☐ R-2421-AF	UNRFPR ☐ R-2639-AF
U ☐ R-1889/1-AF	U ☐ R-2184/2-AF	U ☐ R-2429-AF	U ☐ R-2662-AF
U ☐ R-1894-AF	U ☐ R-2194-AF	U ☐ R-2432-AF	U ☐ R-2665-AF
U ☐ R-1903-AF	U ☐ R-2196-1-AF	U ☐ R-2435-AF	U ☐ R-2687-AF
S ☐ R-1941/1-AF	U ☐ R-2211-AF	U ☐ R-2436-AF	S ☐ R-2688-AF
S ☐ R-1941/2-AF	U ☐ R-2218-AF	U ☐ R-2440-AF	S ☐ R-2688/1-AF
UFOUO ☐ R-1941/3-AF	S ☐ R-2226-AF	S ☐ R-2469-1-AF	U ☐ R-2719-AF
U ☐ R-1949-AF	S ☐ R-2230-1-AF	U ☐ R-2473-AF	U ☐ R-2727-AF
U ☐ R-1973-AF	S ☐ R-2232-AF	U ☐ R-2476-AF	S ☐ R-2736-AF
UNRFPR ☐ R-1976-AF	S ☐ R-2233-AF	S ☐ R-2491-AF	S ☐ R-2741-AF
U ☐ R-1977/1-1-AF	U ☐ R-2243-AF	U ☐ R-2522-AF	U ☐ R-2752-AF
U ☐ R-1977/2-AF	U ☐ R-2249-AF	U ☐ R-2528-AF	C ☐ R-2757-AF
U ☐ R-1977/3-AF	U ☐ R-2264-AF	S ☐ R-2529-AF	U ☐ R-2785-AF
U ☐ R-1977/4-AF	S ☐ R-2265-1-AF	U ☐ R-2541-AF	U ☐ R-2813-AF
U ☐ R-1979-AF	S ☐ R-2269-1-AF	S ☐ R-2563-AF	U ☐ R-2831-AF
U ☐ R-1979/1-AF	U ☐ R-2276-AF	U ☐ R-2565-AF	U ☐ R-2837-AF
S ☐ R-1983-AF	U ☐ R-2276/1-AF	U ☐ R-2566-AF	S ☐ R-2860-AF
U ☐ R-2003-AF	U ☐ R-2281-AF	U ☐ R-2567-AF	C ☐ R-2860/1-AF
U ☐ R-2017-AF	U ☐ R-2287-AF	U ☐ R-2572-1-AF	U ☐ R-2861-AF
S ☐ R-2036-AF	U ☐ R-2308-AF	U ☐ R-2579-AF	U ☐ R-2867-AF
UNRFPR ☐ R-2047-AF	C ☐ R-2320-AF	U ☐ R-2580-AF	U ☐ R-2886-AF
U ☐ R-2049-AF	U ☐ R-2334-AF	U ☐ R-2584-AF	U ☐ R-2896-AF
U ☐ R-2064/1-AF	U ☐ R-2345-AF	S ☐ R-2591/1-1-AF	S ☐ R-2900-AF
U ☐ R-2064/2-AF	SFRD ☐ R-2346-AF/RC	S ☐ R-2591/2-1-AF	U ☐ R-2907-AF
U ☐ R-2098-AF	U ☐ R-2360-AF	S ☐ R-2592-AF	U ☐ R-2908/1-AF *
S ☐ R-2100-AF	U ☐ R-2367-AF	S ☐ R-2592/1-AF	U ☐ R-2908/2-AF *
U ☐ R-2103-AF	U ☐ R-2379-AF	U ☐ R-2598-AF	C ☐ R-2913-AF
U ☐ R-2103/1-AF	U ☐ R-2391-AF	S ☐ R-2599-AF	S ☐ R-2923-AF
C ☐ R-2117-AF	U ☐ R-2401-AF	U ☐ R-2601-AF	U ☐ R-2943-AF

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S ☐ R-2951-AF	U ☐ R-3265-AF	C ☐ R-3527-AF *	U ☐ N-1327-AF
U ☐ R-2954-DOS/AF	C ☐ R-3268-AF	U ☐ R-3530-AF *	S ☐ N-1336-AF
UFOUO ☐ R-2963-AF	U ☐ R-3269-AF	U ☐ R-3541-AF *	U ☐ N-1337-AF
U ☐ R-2994-AF	U ☐ R-3276-AF	U ☐ R-3550-AF *	U ☐ N-1342-AF
U ☐ R-2997-AF/RC	S ☐ R-3278-AF	U ☐ R-3584-AF *	U ☐ N-1450-AF
U ☐ R-3000-AF	S ☐ R-3279-AF	C ☐ R-3587-AF *	S ☐ N-1459-AF
S ☐ R-3004-AF	U ☐ R-3302-AF	U ☐ R-3588-AF *	U ☐ N-1460-AF
U ☐ R-3021-AF	U ☐ R-3303-AF	U ☐ R-3588/1-AF *	S ☐ N-1462-AF
U ☐ R-3028-AF	S ☐ R-3304-AF	U ☐ R-3604/1-AF *	S ☐ N-1464-1-AF
U ☐ R-3036-AF	U ☐ R-3304/1-AF	U ☐ R-3612-AF *	U ☐ N-1476-AF
U ☐ R-3046-AF	U ☐ R-3310-AF	U ☐ R-3660-AF *	U ☐ N-1478-AF
U ☐ R-3060-AF	U ☐ R-3316-AF	U ☐ R-3664-AF *	S ☐ N-1481-AF
U ☐ R-3061-AF	U ☐ R-3318-AF *	U ☐ R-3698-AF *	U ☐ N-1482-AF
C ☐ R-3079-AF	U ☐ R-3332-AF	U ☐ N-1000-AF	SRD ☐ N-1485-AF
U ☐ R-3085-AF	U ☐ R-3333-AF	S ☐ N-1003-AF	U ☐ N-1489-AF
SRD ☐ R-3089-AF	SFRD ☐ R-3336-AF	U ☐ N-1013-1-AF	C ☐ N-1490-AF
C ☐ R-3111-AF	S ☐ R-3340-AF *	U ☐ N-1021-AF	U ☐ N-1495-AF
SRD ☐ R-3112-AF	U ☐ R-3342-AF	U ☐ N-1022-AF	S ☐ N-1496-AF
S ☐ R-3113-AF	U ☐ R-3349-AF	U ☐ N-1161-1-AF	S ☐ N-1497-AF
U ☐ R-3113/1-AF	S ☐ R-3354-AF	S ☐ N-1174-AF	SFRD ☐ N-1508-2-AF
S ☐ R-3118-AF	C ☐ R-3356-AF	U ☐ N-1180-1-AF	U ☐ N-1515-AF
S ☐ R-3118/1-AF	S ☐ R-3362-AF *	U ☐ N-1184-AF	SFRD ☐ N-1516-1-AF
U ☐ R-3121-AF	U ☐ R-3368-AF	U ☐ N-1210-AF	U ☐ N-1524-AF
U ☐ R-3125-AF	U ☐ R-3369-AF	U ☐ N-1214-1-AF	U ☐ N-1528-AF
U ☐ R-3133-AF	S ☐ R-3382-AF/A *	U ☐ N-1216-AF	U ☐ N-1530-AF
U ☐ R-3136-AF	S ☐ R-3384-AF	U ☐ N-1217-AF	U ☐ N-1536-AF
S ☐ R-3154-AF	U ☐ R-3385-AF *	C ☐ N-1228-AF	S ☐ N-1560-AF
U ☐ R-3158-AF	U ☐ R-3389-AF *	U ☐ N-1238-AF	U ☐ N-1587-AF
U ☐ R-3159-AF	S ☐ R-3425-AF/A	U ☐ N-1241-AF	S ☐ N-1599-AF
U ☐ R-3160-AF	S ☐ R-3430-AF *	U ☐ N-1247-AF	U ☐ N-1600-AF
SRD ☐ R-3164-AF	S ☐ R-3436-AF/A	U ☐ N-1258-AF	U ☐ N-1603-AF
U ☐ R-3185-AF	S ☐ R-3437-AF *	U ☐ N-1260-AF	SRD ☐ N-1607-AF
U ☐ R-3189-AF	U ☐ R-3439-AF *	U ☐ N-1265-AF	U ☐ N-1615-AF
U ☐ R-3190-AF	C ☐ R-3461-AF	U ☐ N-1269-AF	S ☐ N-1629-AF
UFOUO ☐ R-3198-AF	U ☐ R-3474-AF	U ☐ N-1273-AF	U ☐ N-1633-AF
U ☐ R-3202-AF	U ☐ R-3475-AF *	S ☐ N-1285-AF	S ☐ N-1660-AF
U ☐ R-3208-AF	U ☐ R-3482-AF *	U ☐ N-1295-AF	U ☐ N-1671/1-AF
C ☐ R-3208/1-AF	S ☐ R-3503-AF/DARPA *	U ☐ N-1303-AF	U ☐ N-1671/2-AF
S ☐ R-3213-AF	U ☐ R-3504-AF	U ☐ N-1311-AF	U ☐ N-1671/3-AF
U ☐ R-3255-AF *	U ☐ R-3508-AF	SFRD ☐ N-1323-AF	U ☐ N-1685-AF
S ☐ R-3264-1-AF *	U ☐ R-3521-AF	UNRFPR ☐ N-1326-1-AF	S ☐ N-1696-AF/ARPA

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U ☐ N-1761-1-AF	U ☐ N-1973-AF	S ☐ N-2182-AF	S ☐ N-2388-AF *
C ☐ N-1767-AF	C ☐ N-1974-AF	U ☐ N-2189-AF	U ☐ N-2400-AF
U ☐ N-1794-AF	S ☐ N-1976-RC/AF	S ☐ N-2201-AF	S ☐ N-2409-AF *
UNRFPR ☐ N-1795-AF	S ☐ N-1983-AF	SRD ☐ N-2203-AF	U ☐ N-2413-AF/A
U ☐ N-1797-AF	U ☐ N-1985-1-AF	S ☐ N-2205-AF	U ☐ N-2416-AF *
C ☐ N-1799-AF	U ☐ N-1990-AF	U ☐ N-2209-AF	S ☐ N-2421-AF/A
U ☐ N-1804-AF	U ☐ N-1995-AF	U ☐ N-2211-AF	S ☐ N-2422-AF
C ☐ N-1810-AF	SRD ☐ N-1998-AF	S ☐ N-2218-AF	S ☐ N-2431-AF
U ☐ N-1820-AF	U ☐ N-2001-AF	S ☐ N-2223-AF	U ☐ N-2443-AF *
U ☐ N-1821-AF	U ☐ N-2002-AF	U ☐ N-2227-AF	U ☐ N-2457-AF *
U ☐ N-1822-AF	U ☐ N-2005-AF	U ☐ N-2230-AF	U ☐ N-2472-AF
U ☐ N-1829-AF	S ☐ N-2007-AF	U ☐ N-2241-AF	U ☐ N-2478-AF
U ☐ N-1831-AF	S ☐ N-2008-AF	U ☐ N-2242-AF	U ☐ N-2479-AF
U ☐ N-1840-AF	S ☐ N-2023-AF	U ☐ N-2243-AF	U ☐ N-2482-AF
U ☐ N-1842-AF	U ☐ N-2026-AF	U ☐ N-2244-AF	U ☐ N-2490-AF
S ☐ N-1850/1-AF	U ☐ N-2027-AF	C ☐ N-2246-AF	U ☐ N-2497-AF *
S ☐ N-1850/2-AF	S ☐ N-2032-AF	U ☐ N-2252-AF	U ☐ N-2499-AF *
S ☐ N-1850/3-AF	U ☐ N-2038-AF	S ☐ N-2262-AF	S ☐ N-2514-AF
U ☐ N-1854-1-AF	S ☐ N-2042-AF	SFRD ☐ N-2263-AF	U ☐ N-2526-AF *
U ☐ N-1856-AF	S ☐ N-2051-AF	S ☐ N-2270-AF/RC	U ☐ N-2549-AF
S ☐ N-1858-AF	U ☐ N-2052-AF	U ☐ N-2280-AF	U ☐ N-2551-AF
U ☐ N-1861-AF	SFRD ☐ N-2054-AF	U ☐ N-2283/1-AF *	U ☐ N-2567-AF
C ☐ N-1870-AF	S ☐ N-2057-AF	U ☐ N-2283/2-AF *	U ☐ N-2579-AF *
U ☐ N-1871-AF	U ☐ N-2058-AF	U ☐ N-2283/3-AF *	U ☐ N-2596-AF
U ☐ N-1872-AF	S ☐ N-2060-AF	U ☐ N-2283/4-AF *	S ☐ N-2602-AF
S ☐ N-1873-AF	U ☐ N-2086-AF	S ☐ N-2286-AF	U ☐ N-2604-AF
U ☐ N-1882-AF	U ☐ N-2087-AF	U ☐ N-2294-AF	S ☐ N-2620-AF *
U ☐ N-1883-AF	S ☐ N-2090-AF	U ☐ N-2301-AF	U ☐ N-2629/1-AF
U ☐ N-1885-AF	SRD ☐ N-2098-AF	U ☐ N-2302-AF/RC	U ☐ N-2629/2-AF
U ☐ N-1891-AF	U ☐ N-2102-1-AF	S ☐ N-2312-AF *	S ☐ N-2661-AF *
U ☐ N-1893-AF	S ☐ N-2123-AF	S ☐ N-2314-AF	U ☐ N-2662-AF *
U ☐ N-1906-AF	S ☐ N-2137-AF	S ☐ N-2327-AF	U ☐ N-2688-AF *
U ☐ N-1908-AF	C ☐ N-2153-1-AF	U ☐ N-2335-AF *	U ☐ N-2697-AF *
U ☐ N-1924-AF	U ☐ N-2162-AF	U ☐ N-2339-AF	U ☐ N-2727-AF *
S ☐ N-1926-AF	U ☐ N-2164-AF	S ☐ N-2344-AF	S ☐ N-2735-AF *
S ☐ N-1937-AF	U ☐ N-2165-AF	U ☐ N-2348-1-AF	U ☐ N-2747-AF *
S ☐ N-1937/1-AF	S ☐ N-2171-AF	U ☐ N-2366-AF	U ☐ N-2763-AF *
S ☐ N-1938-AF	S ☐ N-2174/1-AF	S ☐ N-2372-AF/RC	U ☐ N-2769-AF *
U ☐ N-1943-AF	U ☐ N-2180-AF	S ☐ N-2382-AF	U ☐ Disk **
U ☐ N-1968-AF			

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