ESCOLA DE GUERRA NAVAL

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ANÁLISE LOGÍSTICA DA MAIOR OPERAÇÃO DE BUSCA E SALVAMENTO JÁ REALIZADA PELO BRASIL, O SAR SNE 003/09

Rio de Janeiro
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Monografia apresentada à Escola de Guerra Naval, como requisito parcial para a conclusão do Curso de Estado-Maior para Oficiais Superiores.

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RESUMO

O Brasil possui uma imensa área marítima de busca e salvamento sob sua responsabilidade, com cerca de 14,8 milhões de quilômetros quadrados. O desastre do voo Air France 447, no limite nordeste dessa área, mobilizou 11 navios da Marinha do Brasil, em coordenação com a Força Aérea Brasileira. A necessidade de reabastecimentos de óleo, água doce, sobressalentes e outros materiais; a execução de reparos no mar; o manuseio e armazenamento de corpos em decomposição a bordo dos navios; e a retirada de significativa quantidade de destroços e bagagens da aeronave acidentada, aliados à longa distância do litoral brasileiro e, consequentemente, das bases e depósitos navais, representou um desafio logístico nunca antes enfrentado pela Marinha do Brasil. A existência de um aeródromo na ilha de Fernando de Noronha como ponto intermediário de apoio, contribuindo para que diversas ações logísticas pudessem ser conduzidas, leva o leitor à reflexão sobre a importância da construção de uma pista de pouso na ilha da Trindade e da conveniência da implantação de bases aeronavais nas duas ilhas oceânicas. As grandes distâncias evidenciaram a carência de um sistema de entrega expedita de suprimentos a navios no mar por aviões. O tema é abordado sob o enfoque das funções logísticas estabelecidas na Doutrina de Logística Militar de Defesa brasileira. O estudo do episódio proporciona uma excepcional fonte de ensinamentos para o desenvolvimento da logística naval em operações futuras.

Palavras-chave: Air France 447. Busca e salvamento (SAR). Logística. Ilha de Fernando de Noronha. Ilha da Trindade.

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1 INTRODUÇÃO

Na noite do dia 31 de maio de 2009, às 19:30 h, decolou do aeroporto internacional do Galeão, na cidade do Rio de Janeiro, o voo número 447 da empresa aérea Air France (AF 447), com destino a Paris. A aeronave A330, entretanto, nunca chegou à França, tendo ocorrido sinistro, ainda de causas desconhecidas, levando à sua queda no oceano Atlântico. Não houve sobreviventes entre os 216 passageiros e 12 tripulantes.

Na manhã do dia 1º de junho de 2009, atendendo a compromissos internacionais relativos à responsabilidade brasileira de busca e salvamento (SAR[1]) e imediatamente após ser informada do desaparecimento da aeronave pela Força Aérea Brasileira (FAB), a Marinha do Brasil (MB) fez desatracarem, às 09:15 h, o Navio-Patrulha “Grajaú”, navio de serviço distrital (NSD) no 3º Distrito Naval, em Natal; às 10:15 h, de Maceió, a Corveta “Caboclo”, navio de salvamento distrital (NSalv) das áreas do 2º e 3º Distritos Navais; e, às 17:00 h, do porto de Salvador, a Fragata “Constituição”. Iniciava-se, assim, a maior operação SAR já realizada pelo Brasil, denominada pela MB como SAR SNE 003/09.

A localização do ponto estimado de queda da aeronave, a 597 milhas náuticas (cerca de 1100 km) da base naval mais próxima, na cidade de Natal, e a 425 milhas náuticas do aeródromo mais próximo (cerca de 790 km), na ilha de Fernando de Noronha, por si só, já anunciava o desafio logístico e operacional que representou o socorro ao voo 447.

As buscas foram efetuadas, em coordenação com a FAB, em uma área equivalente à do Estado do Rio Grande do Sul. Os Navios empregados na operação totalizaram quase 200 dias de mar e navegaram mais de 40.000 milhas náuticas. A operação SAR, contínua e ininterrupta por 26 dias, permitiu o recolhimento de corpos das vítimas e de diversas partes destroçadas da aeronave, além de bagagens e objetos pessoais. As caixas-pretas, até o momento, não foram localizadas.

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[1] Sigla internacional para *search and rescue*, busca e salvamento em português (Tradução nossa).

O SAR SNE 003/09 impôs à MB a tempestiva execução de uma complexa estrutura logística. Óleo combustível, gêneros alimentícios, aguada, sobressalentes e diversos outros materiais, foram obtidos e providos aos meios navais e aeronavais que operavam a longa distância do nosso litoral.

Para tal, foi estabelecida uma ponte logística utilizando-se navios da MB, aeronaves da FAB, além de uma base no arquipélago de Fernando de Noronha (AFN). O Navio-Tanque "Almirante Gastão Motta", a Corveta "Caboclo" e o Rebocador de Alto Mar "Triunfo", além de participarem ativamente das buscas, proveram o apoio logístico móvel necessário, realizando transferências de óleo combustível e aguada no mar, prolongando, assim, a permanência dos navios da MB e da Marinha Nacional da França (MNF) na área de buscas.

A operação dos meios navais a grandes distâncias de suas bases pôs à prova a capacidade da MB de prestar apoio logístico e de efetuar reparos no mar, mantendo inalterada a operacionalidade dos seus navios. As tripulações solucionaram diversos óbices e dificuldades, consequentes de uma operação inopinada e sem planejamento prévio.

O propósito da presente monografia é, no que se refere à MB, analisar as ações desenvolvidas durante a operação SAR SNE 003/09 sob a ótica das funções logísticas. É fundamental ressaltar que alguns dos fatos descritos não constam de qualquer bibliografia, sendo fruto das notas e experiências deste autor, que participou ativamente da operação, quando exercia o cargo de Comandante da Corveta "Caboclo".

O segundo capítulo abordará o compromisso internacional de busca e salvamento assumido pelo Brasil e sua área de responsabilidade SAR. O terceiro capítulo apresentará dados de interesse logístico afetos à operação e o quarto capítulo analisará as ações desenvolvidas, abordando-as de acordo com sua função logística correlata. Na conclusão, serão agrupados os principais ensinamentos colhidos.

2 A BUSCA E SALVAMENTO NO BRASIL

Segundo Fonseca (2008), a Convenção sobre o Alto-Mar, adotada em 1958, durante a Conferência das Nações Unidas Sobre o Direito do Mar, estabeleceu que todos os Estados costeiros deveriam promover a criação e manutenção de um serviço de busca e salvamento que garantisse, de modo adequado e eficaz, a segurança no mar e sobre o mar.

Em 1974, a Convenção Internacional para a Salvaguarda da Vida Humana no Mar (SOLAS) estabeleceu que cada governo contratante se obrigava à garantia das medidas necessárias para a vigilância de suas costas e salvamento de pessoas em perigo no mar. Para tal, devem utilizar e manter as instalações marítimas necessárias, considerando a intensidade do tráfego no mar e os perigos da navegação e, na medida do possível, fornecer os meios adequados para a localização e salvamento das pessoas em perigo (BRASIL, 2010).

Em 1979, a Organização Marítima Internacional, agência das Nações Unidas especializada em assuntos marítimos, promoveu uma nova conferência na cidade de Hamburgo, onde foi aprovada a Convenção Internacional de Busca e Salvamento Marítimo que atribuiu áreas de responsabilidade marítima aos governos dos estados costeiros. A eles coube a implantação de prescrições específicas e princípios básicos de busca e salvamento, de modo a aumentar a probabilidade de sucesso em operações SAR (BRASIL, 2010).

O Brasil tem sob sua responsabilidade SAR, uma extensa área do oceano Atlântico, que abrange toda costa brasileira, estendendo-se até o meridiano de 10º oeste, partindo do Cabo Orange até o Arroio Chuí. Sua área aproximada é de 14,8 milhões de quilômetros quadrados, quase 3,5 vezes a Amazônia Azul[2]. Pode-se observar a imensidão abrangida por essa área na FIG. 1.

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[2] Área marítima com cerca de 4,4 milhões de Km^2, que inclui o mar territorial, a zona contígua, a zona econômica exclusiva e parte da plataforma continental brasileira, onde o Brasil manifesta sua exclusividade de exploração econômica.

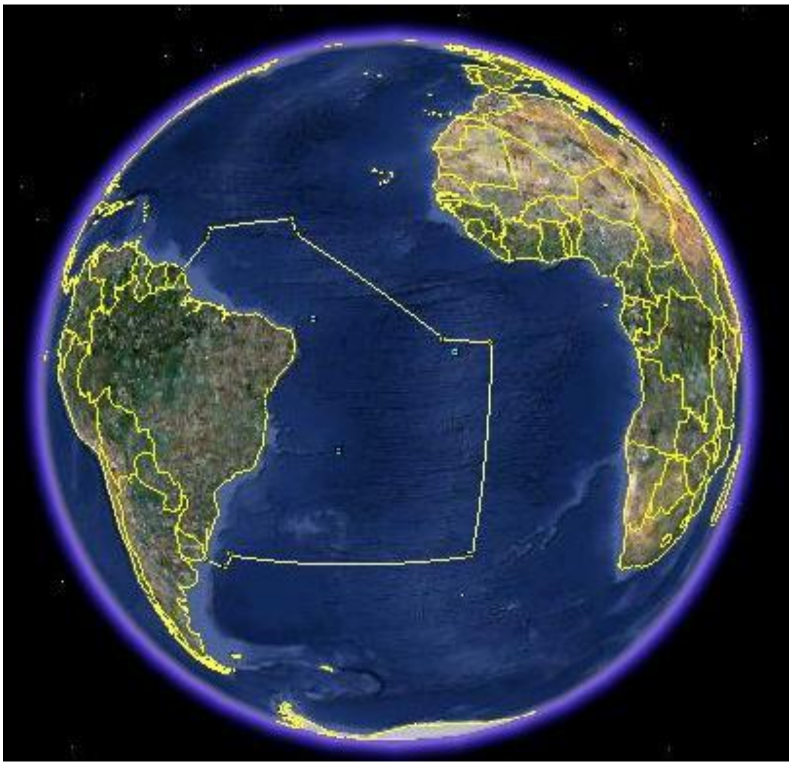

FIGURA 1 - Área de responsabilidade SAR brasileira

A MB possui um serviço de busca e salvamento (SALVAMAR) que visa a prover o auxílio a pessoas em perigo no interior dessa imensa área marítima de responsabilidade brasileira. O SALVAMAR BRASIL é o órgão coordenador, a quem compete a supervisão das atividades SAR e a elaboração das normas necessárias ao seu adequado funcionamento, estando estruturado dentro do Comando de Operações Navais (BRASIL, 2010).

Para facilitar a condução das ações SAR, a área de responsabilidade brasileira foi dividida em cinco sub-regiões marítimas: SALVAMAR SUL, SALVAMAR SUESTE, SALVAMAR LESTE, SALVAMAR NORDESTE e SALVAMAR NORTE, sediadas, respectivamente em: Rio Grande-RS, Rio de Janeiro-RJ, Salvador-BA, Natal-RN e Belém-PA (BRASIL, 2010).

Ao SALVAMAR compete, ainda, a responsabilidade das operações SAR nas vias navegáveis interiores da bacia Amazônica e do rio Paraguai.

Os principais recursos disponíveis para utilização nas operações SAR são os navios e aeronaves subordinados aos Comandos dos Distritos Navais (DN) e, para o pronto atendimento de incidentes SAR, cada DN deverá dispor de um NSD (BRASIL, 2010).

A MB e a FAB efetuaram, em dezembro de 2008, um acordo operacional que estabelece os procedimentos para agilizar o apoio mútuo entre o Sistema de Busca e Salvamento Aeronáutico e o SALVAMAR, onde está previsto que incidentes SAR envolvendo aeronaves sobre o mar são de responsabilidade dos centros de coordenação de salvamento (RCC) aeronáuticos. Quando for necessário o apoio de meios marítimos, os RCC aeronáuticos os solicitarão ao RCC marítimo responsável pela porção de mar envolvida (BRASIL, 2008a).

Dessa maneira, entende-se que, diante da responsabilidade SAR assumida pelo Brasil junto à comunidade internacional, a MB busca estar organizada e pronta, com os meios navais de que dispõe, para enfrentar o desafio de salvaguardar a vida humana em uma área marítima com dimensão equivalente a uma vez e meia o território continental brasileiro. No caso de acidentes com aeronaves sobre o mar, o RCC marítimo atuará em coordenação com o RCC aeronáutico estabelecido pela FAB, apoiando-o com os meios navais necessários. A coordenação de esforços e o apoio mútuo entre os meios da MB e da FAB são fundamentais para o sucesso SAR, como ocorreu na operação SAR SNE 003/09.

3 DADOS LOGÍSTICOS GERAIS DO SAR SNE 003/09

Para que se compreenda a dimensão do esforço logístico necessário à operação SAR SNE 003/09, é preciso conhecer os meios navais empregados, as distâncias até o ponto estimado da queda do avião, o tamanho da área de buscas, o número de corpos encontrados, a quantidade de destroços recolhidos e a relação dos principais materiais consumidos.

Nesse sentido, a TAB. 1 reúne os principais dados dos meios apoiados pela logística da MB (SAUNDERS, 2009). Constata-se que, entre os navios brasileiros, dois possuíam mais de 50 anos de operação (G31 e V19) e nenhum fora comissionado há menos de 12 anos. Verifica-se, ainda, o reduzido raio de ação dos navios-patrulha, das fragatas brasileiras e da Corveta "Jaceguai".

TABELA 1

Dados de interesse logístico dos meios apoiados pela MB

NAVIO	**TRIPULAÇÃO**	**DESLOCAMENTO PADRÃO (toneladas)**	**RAIO DE AÇÃO (milhas náuticas)**	**ANO DE COMISSIONAMENTO**
NDD RIO DE JANEIRO (G31)	223	6.880	14.800 a 12 nós	1956
FRAGATA CONSTITUIÇÃO (F42)	209	3.200	5.300 a 17 nós	1978
FRAGATA BOSÍSIO (F48)	239	3.500	4.500 a 18 nós	1982
NT ALTE GASTÃO MOTTA (G23)	121	4471	9.000 a 15 nós	1991
CORVETA JACEGUAI (V31)	145	1.600	4.000 a 15 nós	1991
CORVETA CABOCLO (V19)	64	911	6.800 a 13 nós	1955
RbAM TRIUNFO (R23)	44	819	8.500 a 10 nós	1986
NPa BOCAINA (P62)	32	770	4.500 a 10 nós	1986
NPa GRAJAÚ (P40)	29	197	2.200 a 12 nós	1993
NPa GUAÍBA (P41)	29	197	2.200 a 12 nós	1994
NPa GOIANA (P43)	29	197	2.200 a 12 nós	1997
LHD MISTRAL (MNF)	177	16.529	11.000 a 15 nós	2006
FRAGATA VENTOSE (MNF)	114	2.600	9.000 a 15 nós	1993

O centro da área de busca inicial foi estabelecido no ponto de coordenadas de 02º58.08' de latitude norte e 030º35.04' de longitude oeste. Essa área, entretanto, foi sendo deslocada, afastando-se do continente, de acordo com a situação, considerando-se a corrente marítima predominante na área e as informações dos destroços encontrados. Na FIG. 2, observa-se o ponto estimado de queda da aeronave, próximo ao limite nordeste da área de responsabilidade SAR brasileira.

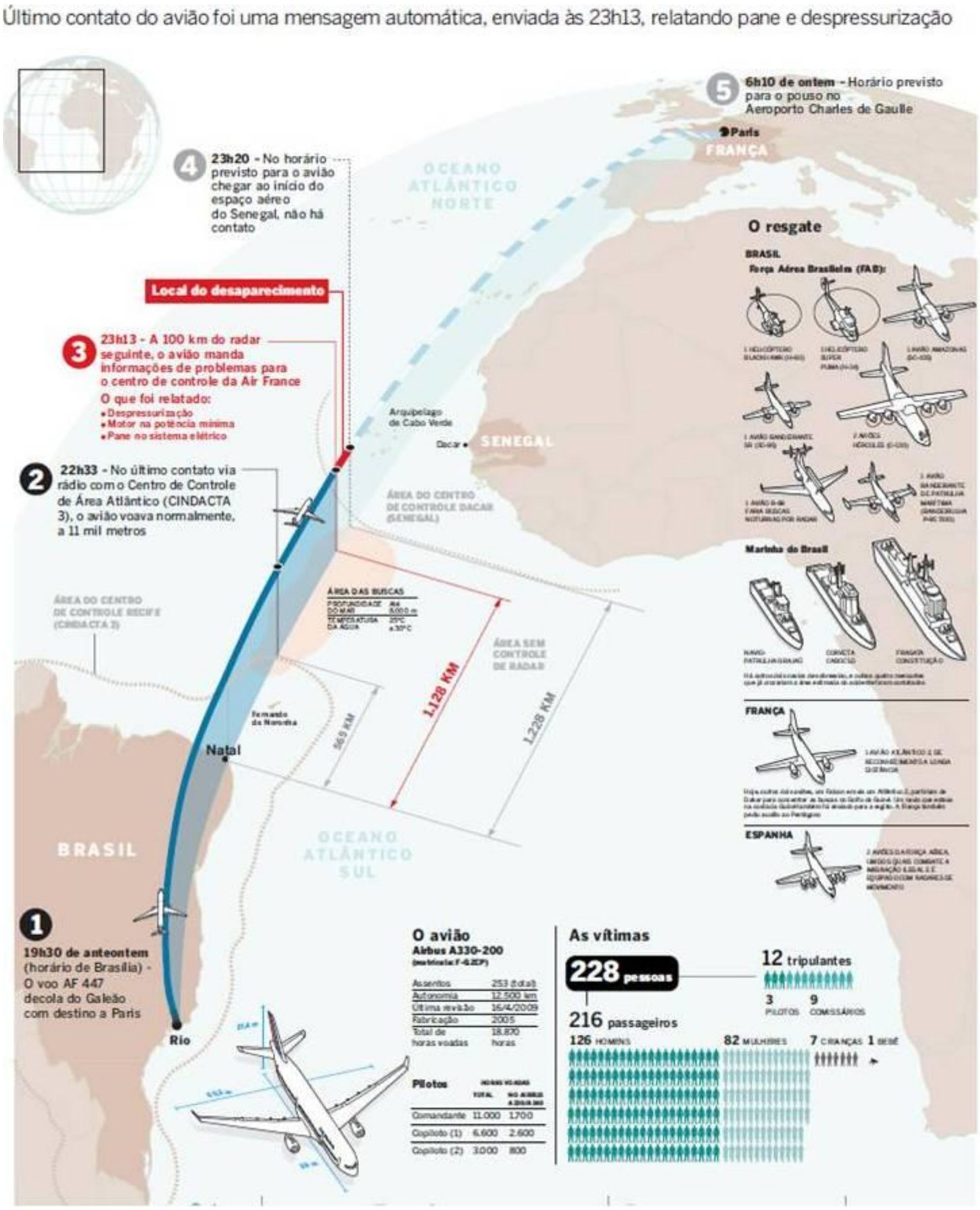
Último contato do avião foi uma mensagem automática, enviada às 23h13, relatando pane e despressurização

FIGURA 2 – Local do desaparecimento do voo 447

Fonte: MAROTTO; LARA; PAIVA; MULLER, 2009.

Como mencionado no capítulo anterior, as buscas marítimas foram efetuadas em coordenação com a FAB, em uma área de 280.000 metros quadrados. Os navios da MB empregados na operação totalizaram 191 dias de mar e 41.573 milhas náuticas navegadas, além de cerca de 170 horas de voo das aeronaves orgânicas embarcadas. Foram cerca de 1.400 militares a bordo dos navios, além do pessoal em terra, militares e civis empregados no necessário apoio logístico e operacional, como se pode observar na TAB. 2.

TABELA 2

Efetivo, horas de voo, milhas navegadas e dias de mar dos navios da MB

NAVIOS	F48	F42	G23	V19	P41	V31	G31	P62	R23	P43	P40	TOTAL
EFETIVO DE MILITARES	204	217	106	51	30	131	467	42	44	34	29	1.355
HORAS DE VOO	69,6	18,1	X	X	X	10,8	71,2	X	X	X	X	169,7
MILHAS NAVEGADAS	7.162	4.748	4.242	3.670	4.357	4.538	3.383	948	3.897	2.330	2.298	41.573
DIAS DE MAR	27	17	21	18	21,5	22	17,5	5	19	11	12	191

Os 26 dias contínuos de operação permitiram o recolhimento de 50 corpos e mais de 600 partes destroçadas da aeronave e de objetos pessoais das vítimas (SILVA; MONTEIRO, 2009).

A operação SAR SNE 003/09 teve dimensão logística nunca antes conduzida pela MB. Os desafios apresentados surgiram de modo repentino e inesperado e exigiram uma resposta tempestiva e eficaz dos meios navais distritais e da Esquadra, que operaram a grandes distâncias de suas bases e, inicialmente, sem data prevista de regresso ao porto sede (SILVA; MONTEIRO, 2009).

Diante dos dados apresentados, verifica-se que a MB enfrentou um vultoso problema logístico ao empregar 11 navios, alguns antigos e com pequenos raios de ação, a longa distância do litoral brasileiro e, portanto, das bases e depósitos navais. O problema foi, ainda, agravado pela necessidade de atuação imediata e pelo caráter inopinado, características intrínsecas de um evento SAR.

4 ANÁLISE DAS FUNÇÕES LOGÍSTICAS NO SAR 003/09

Função Logística é o agrupamento de atividades logísticas afins, correlatas, ou de mesma natureza, sob a mesma designação. São elas: recursos humanos, saúde, suprimento, manutenção, engenharia, transporte e salvamento (BRASIL, 2002).

Neste capítulo analisaremos as atividades desenvolvidas pela MB durante o SAR SNE 003/09, organizando-as de acordo com as funções logísticas correlatas. Dessa maneira será possível entender o esforço desenvolvido para a solução do problema logístico apresentado no capítulo anterior.

Podemos definir o problema logístico operativo estabelecendo a necessidade de se proporcionar os meios ou os recursos, de toda natureza, necessários às forças, na quantidade, qualidade, momento e lugar adequados, de acordo com as circunstâncias impostas. Para a sua resolução, faz-se necessário um esforço logístico, que é o necessário na identificação do que deve ser feito e do como fazê-lo (BRASIL, 2003).

Nenhuma atividade da função logística engenharia foi conduzida durante a operação, motivo pelo qual ela não será objeto deste estudo.

4.1 Recursos humanos

A função logística recursos humanos agrupa as atividades afetas ao gerenciamento do pessoal necessário para o emprego das forças navais, aeronavais e de fuzileiros navais e ao funcionamento das organizações militares da MB (BRASIL, 2003).

As atividades desta função logística são: levantamento das necessidades, procura e admissão, preparação, administração além do bem-estar e manutenção do moral. Identificamos na operação SAR SNE 003/09 ações ligadas às duas últimas, pois as demais são permanentemente executadas pelos órgãos de planejamento, seleção e formação de pessoal da MB.

4.1.1 Administração

A administração é uma atividade que gerencia os efetivos prontos[3], de modo a prover os necessários recursos humanos às organizações militares (BRASIL, 2002).

Durante a operação SAR SNE 003/09, a MB avaliou ser conveniente que os Comandantes dos navios envolvidos não acumulassem a função de Comandante da Cena de Ação[4] (CCA). No dia 6 de junho, o CCA designado e dois oficiais assessores, um deles com fluência na língua francesa, todos provenientes do Rio de Janeiro, embarcaram na Fragata "Bosísio", por helicóptero, nas proximidades do arquipélago de Fernando de Noronha (AFN).

Além das vantagens de um oficial superior exclusivamente dedicado ao Comando das ações, a designação de um Capitão-de-Mar-e-Guerra (CMG) como CCA mostrou-se oportuna quando o Navio-Anfíbio "Mistral", da MNF, apresentou-se na área de buscas sob o comando de um CMG.

Portanto, em situações semelhantes, para que a MB exerça a efetiva coordenação das ações, é recomendável que se faça representar por um oficial de posto equivalente ou superior ao dos comandantes dos navios de outros Estados participantes da operação. Além disso, entende-se que, dependendo das dimensões do evento SAR, a dedicação exclusiva de um oficial como CCA pode ser conveniente.

A presença de um assessor do CCA com fluência no idioma dos navios estrangeiros facilitou a coordenação das ações, minimizando ruídos nas comunicações.

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[3] Efetivo de militares capacitados e disponíveis para o serviço.

[4] Oficial designado para coordenar as operações de busca numa determinada área.

Foi necessária a troca dos militares dos destacamentos aéreos embarcados entre a Fragata “Constituição” e a Fragata “Bosísio”, fato que ocorreu em 12 de junho.

Em decorrência da grande repercussão do acidente junto à mídia nacional e internacional, como se observa na FIG. 3, o Centro de Comunicação Social da Marinha (CCSM) destacou uma equipe, chefiada por um Capitão-de-Fragata, para a cidade de Recife, aonde a FAB coordenava o SAR. Além disso, um oficial superior foi enviado para o Rio de Janeiro, para manter contato direto com os parentes das vítimas que se encontravam hospedados em hotel na cidade. A notícia de que corpos foram encontrados e recolhidos foi divulgada à imprensa após informação prévia aos familiares (ROCHA, 2009). Esse foi um cuidado observado a cada nova informação a ser divulgada.

A REPERCUSSÃO NO MUNDO

O acidente da Air France foi manchete durante todo o dia nos principais sites de jornais europeus. O assunto ganhou grande repercussão mesmo antes da divulgação da lista de passageiros, já que Paris é porta de entrada no continente. Mais de cem pessoas a bordo eram europeias, sendo 61 francesas e 26 alemãs. Já os principais sites americanos, com exceção da CNN Internacional, deram mais destaque ao pedido de concordata da GM

Buscan en el Atlántico el avión desaparecido con 228 personas

El País
Avião desaparecido com 228 pessoas é procurado no Atlântico

Radio France Internationale:
Avião da Air France desaparecido

Hopes fade for missing plane survivors

CNN
Chances de sobreviventes em avião desaparecido diminuem

French plane lost in ocean storm

BBC
Avião francês desaparecido em tempestade oceânica

Vol Rio-Paris : les recherches se poursuivent sans grand espoir de retrouver des survivants

Le Monde
Voo Rio-Paris: Buscas continuam sem grandes esperanças de haver sobreviventes

FIGURA 3 – Repercussão junto à mídia internacional

Fonte: COSTA *et al*., 2009.

O gerenciamento de militares componentes de efetivos prontos foi necessário para o provimento dos recursos humanos adequados em tempo e lugar, durante toda a operação SAR. A presença de um CMG foi fundamental para a permanente e efetiva coordenação da operação pela MB. A participação de oficias com as competências requeridas para tarefas específicas facilitou a condução das ações. Observou-se que o deslocamento de equipes de comunicação social para pontos-chave, como Rio de Janeiro e Recife, foi importante para que as informações pudessem ser transmitidas adequadamente aos familiares das vítimas e à sociedade.

4.1.2 Bem-estar e manutenção do moral

A atividade bem-estar e manutenção do moral, desenvolvida durante toda a operação, visa a manter o pessoal nas condições psicossociais adequadas ao serviço e compreende, entre outras, ações voltadas para o atendimento de necessidades como repouso e recuperação (BRASIL, 2003). Havia a preocupação constante com o desgaste físico e mental das tripulações, que trabalharam dia e noite na busca e recolhimento de corpos e destroços da aeronave. Nos navios distritais, o desgaste foi ainda maior, devido ao menor efetivo de militares, o que não permitiu o sistema de voluntariado para as tarefas de recolhimento e manuseio de corpos. O serviço de vigilância foi reforçado para que se aumentasse a capacidade de detecção visual de vestígios da aeronave desaparecida, porém outros serviços administrativos puderam ser suprimidos, com o intuito de se minimizar o cansaço das tripulações.

Deve-se considerar que os navios fizeram, em média, 17 dias de mar nessa operação e que alguns deles foram acionados após outras longas e recentes comissões, como a Corveta “Caboclo” que se encontrava atracada em Maceió, recém-chegada de uma viagem à Namíbia e a Fragata “Constituição” que estava atracada no porto de Salvador, como escala de regresso de uma viagem aos Estados Unidos da América e Caribe, totalizando, na ocasião, 68 dias fora de sua sede, conforme descrito no periódico NOMAR on-line[5].

Depreende-se, portanto, que a manutenção do bem-estar e moral de nossas tripulações deve ser uma preocupação constante dos Comandantes de navios, principalmente

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[5] http://www.mar.mil.br/hotsites/nomar/atuais/806/806.pdf

em períodos prolongados de afastamento de suas sedes. Uma tripulação cansada ou com o moral corroído não apresentará o seu melhor rendimento quando submetida a condições extremas que exijam grande esforço físico e emocional.

4.2 Saúde

A função logística saúde reúne as atividades relativas à manutenção do pessoal nas condições físicas e psíquicas adequadas, por meio de providências sanitárias preventivas e de recuperação (BRASIL, 2002). Ela é um indispensável suporte a todos os tipos de operação naval e contribui, de modo decisivo, para a manutenção da capacidade máxima de operação e no moral elevado das tripulações (BECMAN, 2002).

Dessa função logística tiveram lugar no SAR SNE 003/09 as medicinas preventiva e curativa. A primeira visando a manter a saúde física e mental dos recursos humanos, realizando diagnósticos precoces, pronto tratamento e medidas profiláticas, reduzindo custos com evacuação e hospitalização. A segunda proporcionando o efetivo tratamento a doentes e feridos a fim de restabelecê-los, com a maior brevidade possível, às condições psicofísicas para retorno às atividades normais (BRASIL, 2003).

4.2.1 Medicina preventiva

Os navios envolvidos localizaram 50 corpos e os retiram do mar. O primeiro deles no dia 6 de junho, cinco dias após o acidente e o último no dia 16, passados 15 dias.

De acordo com a Polícia Federal (*apud* TELLES, 2009) os corpos estavam irreconhecíveis, devido ao processo de decomposição e à ação de animais marinhos. Essa notícia é coerente com o estudo dos fenômenos cadavéricos, que indica o início da putrefação

18 a 24 horas após o óbito e afirma que a umidade favorece a maceração[6] (DOUGLAS; KRYMCHANTOWSKI; DUQUE, 2001). Conclui-se, portanto, que todos os corpos recolhidos e manuseados pelas tripulações dos navios envolvidos apresentavam adiantado estado de decomposição.

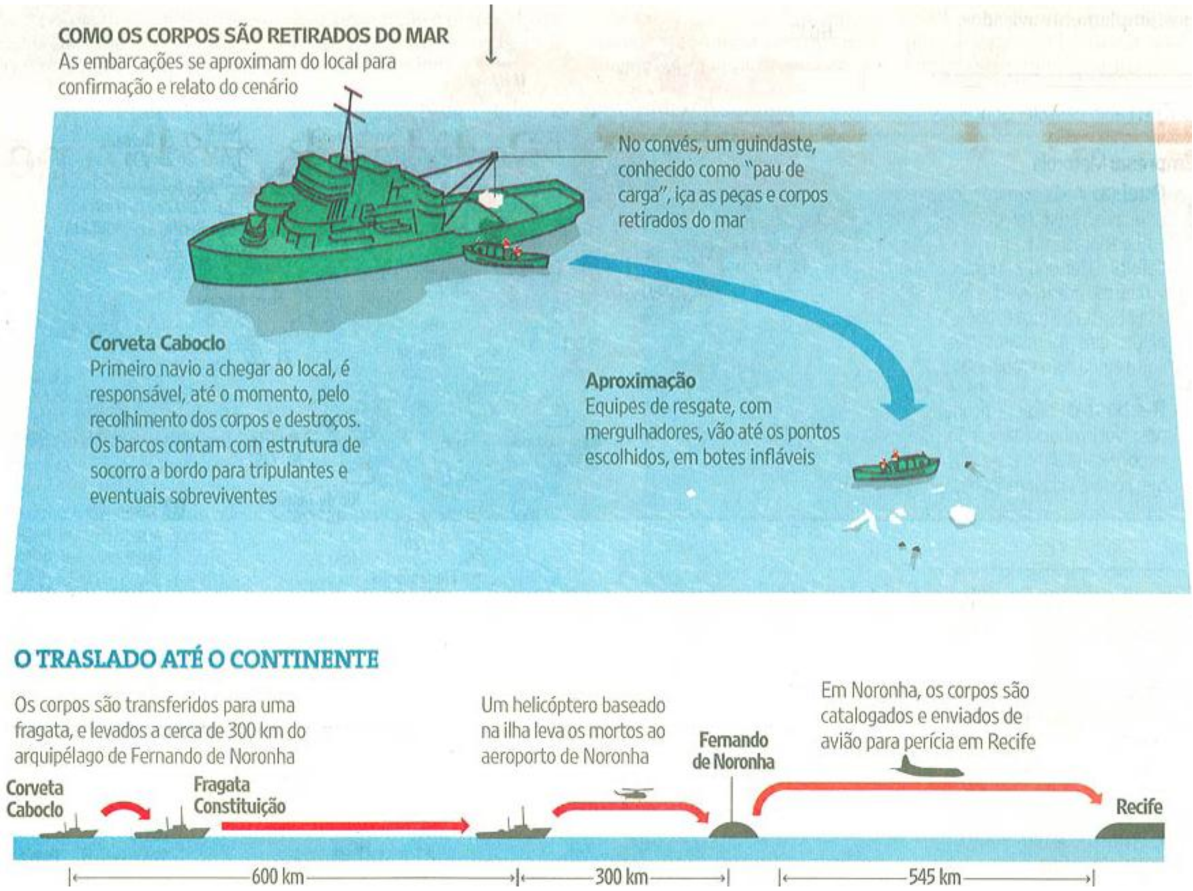

FIGURA 4 – O processo de remoção dos corpos

Fonte: GUIBU, 2009.

A dinâmica da remoção dos corpos, que pode ser observada na FIG. 4, era realizada da seguinte maneira: os navios os recolhiam do mar utilizando mergulhadores e as embarcações orgânicas[7], que eram içadas para bordo por turcos ou guindastes. Os médicos conduziam, então, a perícia cadavérica preliminar cabível. Os corpos eram embalados em sacos mortuários e levados para as câmaras frigoríficas, no caso dos navios da Esquadra. Nos

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[6] Fenômeno cadavérico aonde ocorre a destruição dos tecidos moles, decorrente do excesso de umidade ou presença de muito líquido. Os tecidos se enrugam e depois se desprendem, em pedaços (DOUGLAS; KRYMCHANTOWSKI; DUQUE, 2001).

[7] Botes e lanchas pertencentes a um navio.

navios distritais, eram acondicionados em conveses abertos e, na primeira oportunidade, eram imediatamente desembarcados por meio de lanchas e botes para navios com adequada capacidade de armazenamento em ambiente refrigerado. Os navios da Esquadra seguiam até as proximidades do AFN, para onde os corpos eram transportados por helicópteros. De lá seguiam, em aviões da FAB, até Recife.

Os primeiros navios a chegar na área de buscas não possuíam a quantidade suficiente de sacos mortuários e os poucos disponíveis eram de baixa qualidade, rompendo-se facilmente durante as remoções. O material de proteção individual da tripulação era improvisado. Faltavam máscaras cirúrgicas, roupas descartáveis, óculos de acrílico e luvas de látex, que eram, muitas vezes, reaproveitadas. Isso seria evitado se houvesse uma dotação desse material pré-estabelecida para os NSD e NSalv.

Assim, verifica-se que houve risco de as tripulações adquirirem doenças devido ao manuseio de corpos em estado de decomposição avançado, por vezes, sem o material de proteção adequado. O processo de decomposição ocorre pela ação de bactérias que provoca o desprendimento de gases incômodos e nocivos ao ser humano, causando náusea, vômito, coceira e irritação. Além disso, o contato com as bactérias, sangue e tecidos provenientes de cadáveres pode causar doenças graves (BRASIL, 2009).

Para evitar contaminação, diversas medidas profiláticas foram incrementadas, com ênfase na limpeza e desinfecção dos ambientes aonde os corpos eram manuseados. Como exemplo, a Fragata “Bosísio” esvaziou a câmara frigorífica de verduras e a forrou com material plástico, preparando-a para o armazenamento de corpos. Os corpos embarcados naquele navio percorriam um longo percurso em conveses internos até a frigorífica. O mau cheiro impregnava o navio e houve a necessidade de alterações no sistema de ventilação, para minimizar esse efeito. Foram realizados, ainda, ensaios e adestramentos a fim de diminuir o tempo de transporte pelos conveses internos, conforme descrito na INTRANET-MB[8].

Na Corveta “Caboclo”, que recolheu nove corpos, a lavagem do convés da popa, com uso de água salgada e detergente, era prioridade após cada recolhimento. Os corpos, naquele navio, eram envolvidos em lençóis antes de serem colocados nos sacos mortuários, para evitar que se rasgassem, por contato direto com ossos expostos fraturados, e que houvesse derramamento de material líquido contaminado.

O Navio-Anfíbio “Mistral”, da MNF, único que possuía câmaras mortuárias frigorificadas disponíveis, pôde simplificar muito as medidas necessárias para a conservação dos corpos. Entende-se, portanto, ser recomendável que os projetos futuros dos navios de grande porte da MB contemplem a especificação desses compartimentos a bordo.

Segundo a INTRANET-MB[8], no dia 11 de junho, embarcaram, provenientes de AFN, dois psicólogos franceses, com destino à Fragata “Ventose”, da MNF. A presença desses profissionais foi importante na avaliação das medidas adotadas pela Fragata “Bosísio”, para evitar traumas psicológicos decorrentes do manuseio de corpos. As informações obtidas foram repassadas aos demais navios da MB.

> A coleta de corpos é uma parte dura da missão de resgate e que exige um preparo emocional e psicológico muito grande por parte dos militares envolvidos na busca dos destroços do A330 [...] o recolhimento de restos mortais tem sido uma penosa sucessão de chocantes reproduções da violência da tragédia (AMBROSIO, 2009)

Em 2000, quando o navio USS “Cole”, da Marinha dos Estados Unidos da América (USN), sofreu ataque suicida com explosivos no Iêmen, ferindo 42 tripulantes e causando 17 mortes, foram imediatamente enviados capelães, para assistência religiosa, e uma equipe com integrantes qualificados para o gerenciamento de estresse em incidentes críticos, chefiada por um psiquiatra. Foram identificados, na tripulação do navio, 12 casos de reação

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[8] http://www.comopnav.mb/operacoes/sar/SNE003-09.htm

aguda ao estresse e cerca de 40 casos de insônia na semana seguinte ao ataque (BECMAN, 2002).

Conforme consta na INRANET-MB[9], as tripulações dos navios da MB apresentaram um adequado desempenho emocional durante o evento SAR. No entanto, registrou-se que alguns militares embarcados, apesar de abalados emocionalmente com a tragédia ocorrida, não apresentaram significativa interferência com o desempenho dos trabalhos a bordo. De acordo com a disponibilidade de pessoal em cada navio, foi considerado o voluntariado para a escolha dos militares que recolheram e manusearam os cadáveres.

Este autor entende, portanto, que é desejável o embarque de psicólogos e capelães para o acompanhamento das tripulações, em situações semelhantes à descrita. Dessa forma, caso algum militar venha a apresentar sintomas de abalo emocional, poderá ser orientado por especialistas embarcados ou ser encaminhado a uma unidade de saúde da MB, se houver necessidade de tratamento mais específico. Assim, evita-se o comprometimento das atividades rotineiras de bordo.

4.2.2 Medicina curativa

De acordo com a INTRANET-MB[9], a medicina curativa também teve lugar na operação, quando, em 9 de junho, a Fragata “Ventose”, da MNF solicitou a evacuação aeromédica (EVAM) de um sargento da sua tripulação, que apresentava problemas de coluna, acompanhado de um enfermeiro francês. O CCA determinou o encaminhamento à Fragata “Bosísio” e a remoção para o AFN. O médico da Fragata “Bosísio”, após examinar o doente, solicitou exames complementares em terra por haver suspeita de meningite. No dia 11 de

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[9] http://www.comopnav.mb/operacoes/sar/SNE003-09.htm

junho, os dois militares franceses foram evacuados, por helicóptero, para o AFN e de lá seguiram, por aeronave francesa para Fort de France.

Em 22 de junho, houve a necessidade de EVAM para 2 militares da Fragata “Bosísio” para o Navio Desembarque Doca “Rio de Janeiro”, a fim de receberem atendimento odontológico, o que evidencia a necessidade de haver oficiais dentistas e consultório em pelo menos um dos navios envolvidos em longas comissões.

Considerando que não foram encontrados sobreviventes, observa-se que a medicina curativa foi desenvolvida a contento pelos navios da MB no atendimento de suas tripulações. Porém, cabe-nos refletir sobre a capacidade de medicina curativa disponível, frente a um possível encontro de um grande número de sobreviventes nos primeiros dias de operação.

“Mas a pergunta que fica é: E se tivesse havido sobreviventes? Será que o Brasil possui todos os meios necessários para realizar um resgate de grande porte?” (LORCH, 2009). Caso os pilotos tivessem conseguido pousar a aeronave na água, a quantos sobreviventes feridos e debilitados os navios distritais, primeiros a chegar na cena de ação, teriam que prestar atendimento, contando, cada um, com apenas um médico e um enfermeiro? Difícil responder, mas este autor acredita que, a despeito do maior esforço que fosse realizado, algumas vidas poderiam ser perdidas, por carência de profissionais de saúde e pela necessidade de improviso na operação. O deslocamento expedito para a cena de ação de um navio de grande porte, com adequada capacidade de atendimento médico emergencial, pode ser determinante para que uma medicina curativa de qualidade seja prestada a eventuais sobreviventes.

Portanto, em situações similares, em que o número de sobreviventes pode ser elevado, sugere-se que as equipes médicas embarcadas tenham, no mínimo, dois médicos e três enfermeiros. Os navios devem, por sua vez, possuir um plano de atendimento médico especial pré-definido.

4.3 Suprimento

Suprimento é o grupo de atividades que trata da previsão e provisão do material necessário às organizações e forças apoiadas, e visa ao levantamento das necessidades, obtenção e distribuição (BRASIL, 2002).

Na MB, o suprimento integra-se ao transporte, compondo o conceito mais abrangente de abastecimento, buscando promover o adequado fluxo do material necessário, das fontes de obtenção até as OM consumidoras (BRASIL, 2003).

Todas as atividades dessa função estiveram presentes, permanentemente, ao longo de toda a operação. O caráter inopinado e a grande distância da área de operações para as nossas bases impuseram um grande e inesperado desafio logístico à MB.

Como constatamos na INTRANET-MB[10], as seguintes necessidades foram identificadas e atendidas pelo Sistema de Abastecimento da Marinha: um contêiner frigorificado (instalado a bordo do Rebocador de Alto-Mar “Triunfo”), 200 máscaras cirúrgicas, 60 roupas descartáveis, 60 óculos de acrílico, 150 sacos mortuários, 100 pares de luvas de látex, um bote, um motor de popa, um mangote e suas conexões para transferência de óleo no mar, cinco boias para acompanhamento da deriva de objetos flutuantes, 100 bastões químicos emissores de luz (cyalume), 200 sabonetes, 200 tubos de creme dental, 400 litros de gasolina, sobressalentes diversos, óleo combustível (OC), óleo lubrificante, aguada, gás refrigerante Freon 22 e gêneros alimentícios.

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[10] http://www.comopnav.mb/operacoes/sar/SNE003-09.htm

A Corveta “Caboclo” realizou três transferências de óleo no mar (TOM), totalizando 33.700 litros de OC transferidos para os Navios-Patrulha “Grajaú”, “Guaíba” e “Goiana”, além de abastecer a Corveta “Jaceguai” com 10.000 litros de aguada. O Rebocador de Alto-Mar “Triunfo” transferiu 22.600 litros em três TOM para os Navios-Patrulha da classe “Grajaú” e reabasteceu de aguada, por duas vezes, a Corveta “Jaceguai”, totalizando 58.000 litros de água doce transferidos.

A Corveta “Caboclo” possuía o material necessário para a TOM (mangote, cabos e boias), recém-adquirido para que cumprisse a tarefa de reabastecer o Navio-Patrulha “Brendan Simbwaye”, da Marinha da Namíbia, durante a travessia de Fortaleza a Walvis Bay, naquele país. Além disso, sua tripulação realizou, no 1º semestre de 2009, cerca de cinco adestramentos de TOM com efetivo bombeamento para Navios-Patrulha da classe “Grajaú”. Como, o Rebocador de Alto-Mar “Triunfo” não possuía o material a bordo, recebeu o mangote pertencente ao 3º Distrito Naval, transportado pelo NPa “Goiana”. Sua tripulação não estava familiarizada com os procedimentos cabíveis para a transferência, mas se saiu muito bem nos reabastecimentos realizados.

Dessa forma, entende-se que todos os NSalv devam possuir a bordo material próprio para a realização de TOM, inclusive conjuntos de adaptações para as diversas conexões. As verificações de adestramento da MB devem cobrar a realização do reabastecimento no mar, tanto nas inspeções dos NSalv, quanto nas dos NSD, a fim de garantir a qualidade do material e dos procedimentos. É recomendável, ainda, que essas transferências sejam realizadas durante as comissões de rotina, como ocorre nos navios da Esquadra, garantindo a manutenção do adestramento.

O Navio Desembarque Doca “Rio de janeiro”, a Fragata “Constituição”, a Fragata “Bosísio” e a Corveta “Jaceguai” foram reabastecidas pelo Navio-Tanque “Almirante Gastão Motta”, que realizou oito fainas de TOM com os navios da MB, transferindo cerca de 2,5 milhões de litros de óleo combustível para os meios da nossa Esquadra, de acordo com dados disponíveis na INTRANET-MB[11].

Os navios da MNF, também, apresentaram à MB a necessidade de reabastecimento de OC, sendo atendidos pelo Navio-Tanque "Almirante Gastão Motta", que transferiu, no dia 13 de junho, 800.000 litros para o Navio Anfíbio "Mistral" e 200.000 litros para a Fragata "Ventose".

Para facilitar a compreensão das transferências no mar, a TAB.3 consolida os dados dos reabastecimentos de OC e água doce.

TABELA 3

Transferências de OC e água doce no mar

NAVIO FORNECEDOR	NÚMERO DE TRANSFERÊNCIAS	TOTAL TRANSFERIDO (litros)
G 23	8 de OC para navios da MB	2,5 milhões
G 23	2 de OC para navios da MNF	1 milhão
V 19	3 de OC / 1 de água doce	33.700 / 10.000
R 23	3 de OC / 2 de água doce	22.600 / 58.000

Verifica-se que a imprevisibilidade dos eventos SAR dificulta o planejamento e a prévia obtenção de itens considerados necessários, o que se potencializa nos casos de desastres de grandes proporções, com grande número de vítimas, como foi o do voo 447. Para amenizar esse problema, os Distritos Navais (DN) podem estabelecer um kit de material para acidentes de grande vulto, que deve estar embarcado permanentemente nos NSalv. Este autor sugere que o kit em questão deve ser composto por, no mínimo, o seguinte material: 200 roupas descartáveis, 200 pares de luvas de látex, 40 óculos de acrílico, 200 máscaras bloqueadoras de odor e 100 sacos mortuários reforçados. Além disso, é conveniente que os DN disponham de um contêiner frigorificado, por aquisição ou aluguel, para embarque imediato no NSalv, que não possuem capacidade de armazenamento de corpos.

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[11] http://www.comopnav.mb/operacoes/sar/SNE003-09.htm

É importante registrar que, quando houver a cooperação de navios de outros Estados em operações SAR na área de responsabilidade brasileira, a MB poderá ser instada ao suprimento de suas demandas logísticas.

4.4 Manutenção

É o conjunto de atividades que são executadas visando a manter o material na melhor condição para emprego e, no caso de avarias, efetuar o reparo que o faça retornar àquela condição. Suas atividades são: levantamento das necessidades, manutenção preventiva, manutenção modificadora e manutenção corretiva (BRASIL, 2003).

Durante a operação, a manutenção corretiva teve papel de destaque dentre essas atividades, principalmente na correção de falhas ocorridas de modo inesperado e aleatório nas aeronaves e embarcações orgânicas e nos equipamentos de bordo.

Os meios navais e aeronavais registraram 33 avarias. Desse total, 19 (aproximadamente 60%) foram sanadas no decorrer da operação, muitas apenas com o pessoal e os materiais disponíveis a bordo, o que demonstra a importância da capacitação de pessoal e disponibilidade de ferramentas e peças para a execução de reparos no mar. Quando foi necessário, houve remessas de sobressalentes, bem como o apoio de uma estrutura para reparos de 2º escalão[12], na Base Naval de Natal, o que também demonstrou o relevante apoio que o Sistema de Abastecimento da Marinha e as bases navais podem proporcionar aos navios operando afastados de suas sedes (BRASIL, 2009).

Ressalta-se que o número de falhas de funcionamento é inversamente proporcional à qualidade da manutenção preventiva realizada em cada meio, por bordo e pelas organizações militares prestadoras de serviço. A prevenção é executada de modo planejado e

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[12] Manutenção realizada em outras organizações e que ultrapasse a própria capacidade da organização militar responsável pelo material.

evita baixo desempenho e a ocorrência de avarias, por meio de inspeções, testes, reparações ou substituições (BRASIL, 2003).

Nota-se que, em qualquer operação no mar, a existência de bases navais nas proximidades é essencial para possibilitar manutenções de 2º escalão.

Posto isso, verifica-se que existem diversas ilhas oceânicas no Atlântico Sul, como Cabo Verde**, Fernando de Noronha**, Ascensão, **Trindade**, Santa Helena, Tristão da Cunha, Malvinas, Geórgias do Sul, Sanduíche do Sul. Essas ilhas possuem a utilidade particular para o estabelecimento de bases aéreas e navais. (COUTAU-BÉGARIE, 1985, grifo nosso)

Segundo Corrêa (2009), a tarefa de resgatar os destroços do AF 447 teria sido muito mais simples se o AFN contasse com a permanência de navios-patrulha e significativas unidades da MB e FAB, além de facilidades não implementadas, constantes em projeto do Estado-Maior das Forças Armadas (hoje, Ministério da Defesa) dos anos 1980. Essa estrutura, facilitaria a resolução do problema logístico e abreviaria o tempo de chegada dos meios navais à área de buscas.

FIGURA 5 – Área SAR e o posicionamento da ilha de Trindade e do AFN

Nesse contexto, propõe-se que o leitor observe a FIG. 5 e faça, para si mesmo, as seguintes perguntas: Seria muito sonhar com uma base aeronaval[13] no AFN e uma outra na ilha de Trindade? Que importância essas bases teriam no desempenho de futuras demandas logísticas da MB e FAB? As respostas desses questionamentos, apesar de pertinentes, não serão contempladas no presente estudo para que não se fuja ao escopo do trabalho.

4.5 Transporte

Transporte é o grupo de atividades executadas para se deslocar os recursos humanos e materiais necessários até os locais determinados, a fim de se atender, em tempo, às necessidades, utilizando-se dos diversos meios disponíveis (BRASIL, 2003).

Participa como atividade fundamental para todo o esforço logístico, sendo, primordialmente, um serviço que atende, de alguma forma, às demais funções logísticas para que seus propósitos sejam atingidos (BRASIL, 2003).

O SAR SNE 003/09 teve lugar a meio caminho entre o Brasil e a África, a mais de 600 milhas da base e depósitos navais mais próximos, em Natal. O suprimento identificado na cena de ação como necessário precisava, de alguma forma, chegar até lá para que as necessidades fossem atendidas.

Para resolver o problema do transporte do pessoal e material necessário, a MB utilizou-se de aeronaves comerciais, das idas e vindas dos seus navios e aeronaves e, de modo fundamental, das aeronaves da FAB, que decolavam de Natal e Recife e pousavam no aeródromo do AFN, onde foi estabelecido um ponto intermediário de apoio logístico entre o continente e a longínqua área de buscas.

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[13] Base com capacidade de prover, a navios e aeronaves, facilidades como cais, hangar, energia, abastecimento e manutenção.

Foram transportados: pessoal da MB e da MNF, sobressalentes, gêneros e materiais diversos que, sem o aeródromo do AFN como ponto de apoio, poderiam não ter chegado a tempo a seus destinos, comprometendo, assim, o desempenho dessa função logística.

Dessa maneira, de acordo com Lorch (2009), a ilha de Fernando de Noronha foi grande aliada no apoio às buscas do voo AF447, servindo como um verdadeiro porta-aviões estacionário em alto-mar. Em tempo de paz, ela possibilita o apoio a diversas operações no litoral nordestino e serve de escala para aeronaves que cruzam o Atlântico em direção a Cabo Verde.

Cabe, portanto, a reflexão sobre a importância de se contar com aeródromos permanentemente disponíveis no interior da nossa Amazônia Azul e da área de responsabilidade SAR do Brasil.

A construção de uma pista de pouso e decolagem na ilha de Trindade é um antigo anseio da MB, que ainda não foi realizado por falta de necessidade urgente ou de orçamento suficiente. O arquipélago de Trindade e Martins Vaz está localizado a cerca de 1.150 km da cidade de Vitória e é o ponto do território nacional situado mais a leste (LORCH, 2009), estrategicamente posicionado no centro-sul da área de responsabilidade SAR do Brasil, como já foi observado na FIG. 5. De acordo com Rebouças (1984), a ideia da construção do aeródromo em Trindade vem sendo estudada pela MB e FAB desde o anos 1970. A pista teria 1.300 metros de extensão e custaria, a valores estimados do ano de 1979, 300 milhões de dólares.

A Política de Defesa Nacional (PDN) confere ao Atlântico Sul elevado grau de prioridade, expressando a necessidade de que o Brasil possua a capacidade de vigilância e defesa das águas jurisdicionais brasileiras, além de manter a segurança das linhas de comunicações marítimas (BRASIL, 2005).

A Estratégia Nacional de Defesa (END) tem com uma de suas diretrizes a ampliação da capacidade de atender aos compromissos internacionais de busca e salvamento e afirma que a área marítima que vai de Santos a Vitória merece atenção especial, em relação ao necessário controle do acesso marítimo ao Brasil (BRASIL, 2008).

Caso ocorra um acidente similar ao objeto deste estudo, em um voo partindo de São Paulo com destino a Joanesburgo, na África do Sul, a MB não contará com um ponto de apoio logístico intermediário (LORCH, 2009). Isso nos leva à convicção de que é mais do que desejável a construção do aeródromo em Trindade, a despeito de eventuais restrições orçamentárias e ambientais existentes. No futuro, quanto ele pode ser útil a todos os que cruzam os mares e ares do Atlântico Sul e à sociedade brasileira? Esse assunto, porém, não é objeto do presente trabalho, devendo ser analisado em estudo específico.

Considera-se, ainda, que a disponibilidade e utilização do Navio-Aeródromo “São Paulo” permite o estabelecimento de uma ponte logística móvel em qualquer ponto da área de responsabilidade SAR brasileira, conferindo grande flexibilidade à MB em situações semelhantes. No entanto, para que isso seja possível, a MB deve adquirir aeronaves de asa fixa para transporte de carga, com capacidade de pouso a bordo.

4.5.1 Transporte de Suprimentos para Navios por Aeronave de Asa Fixa

Durante a operação, quando alguns sobressalentes para a Fragata “Bosísio” e Corveta “Jaceguai” chegaram ao AFN, o CCA, que se encontrava embarcado na Corveta “Caboclo”, teve que decidir qual seria a melhor maneira de transportá-los até os seus destinos. Na ocasião, duas linhas de ação (LA) foram a ele sugeridas:

LA 1) O Rebocador de Alto Mar “Triunfo”, que demandava a cena de ação, vindo de Salvador, faria um pequeno desvio até o AFN, embarcaria os sobressalentes por bote e os transportaria para os meios que deles precisavam. Essa LA atrasava a chegada dos sobressalentes nos destinos, mas era totalmente segura; e

LA 2) Os sobressalentes seriam empacotados em caixas à prova d`água com flutuabilidade positiva e seriam lançados pelos aviões C130 da FAB, que diariamente sobrevoavam a área de buscas. Essas caixas seriam lançadas por paraquedas, em pontos de encontro com os meios delas demandantes, como a FAB rotineiramente faz sobre terra. Essa LA atenderia os navios em tempo muito inferior, mas apresentava grau de risco considerável, pois esse lançamento na superfície do mar é atividade desconhecida pela MB e pela FAB, não tendo sido encontrados registros de tentativas efetuadas pelas Forças Armadas Brasileiras.

O CCA decidiu pela LA 1 e os sobressalentes foram embarcados por bote no RbAM "Triunfo", que os transferiu para a Fragata "Bosísio", por helicóptero, e para a Corveta "Jaceguai", por bote.

Nos anos 1970, a USN desenvolveu estudo de avaliação do *"Naval Emergency Air Cargo Delivery System"* (NEACDS), concebido para permitir a entrega de suprimentos prioritários a navios em operação no mar, a partir de aeronaves de asa fixa. O principal objetivo era verificar se o conceito era exequível. Os problemas a resolver eram a vedação da embalagem dos suprimentos, a flutuabilidade, a resistência ao choque e o recolhimento da carga do mar. Foram desenvolvidos procedimentos de coordenação navio-aeronave e estabelecidas tabelas categorizando as cargas. O estudo comprovou a exequibilidade do NEACDS (PUTNAM, Russell H. *et al*., 1977).

Atualmente, a USN desenvolve um sistema de precisão, chamado de *"snowflake"*, para entrega de suprimentos a navios em movimento no mar. Os suprimentos são lançados de aeronaves voando a altas altitudes e são guiados, por paraquedas, até os conveses de voo dos navios a serem supridos (HEWGLEY, Charles W.; YAKIMENKO, Oleg A., 2009).

Segundo Vidigal (1985), aeronaves C130 do Reino Unido realizaram cerca de 40 lançamentos, por paraquedas, para suprir com o material necessário a Força Tarefa Britânica que operava no Conflito das Malvinas (1982).

Considerando as dimensões da Amazônia Azul e da área de responsabilidade SAR brasileira, conclui-se que sistemas similares ao NEACDS e ao *"snowflake"* devem ser desenvolvidos e testados pela MB e FAB. Os sistemas em tela contribuirão para o incremento da interoperabilidade[14] entre as Forças Armadas Brasileiras, previsto na END, além de conferir maior eficiência à função logística transporte, possibilitando e reduzindo, de modo considerável, o tempo de atendimento de futuras necessidades que se apresentem.

4.6 Salvamento

Salvamento é o conjunto de atividades que são executadas visando à salvaguarda e ao resgate de recursos materiais, suas cargas ou itens específicos (BRASIL, 2003). Dentre as diversas atividades dessa função logística, teve lugar de destaque, durante a operação, o resgate de recursos materiais acidentados, cargas ou itens específicos.

Para que fosse aumentada a probabilidade de detecção visual, os serviços de vigilância foram reforçados. Na Corveta "Caboclo", quatro vigias permaneciam 24 horas no tijupá[15], tarefa que, rotineiramente, é realizada por apenas um militar. Além disso, militares que não estavam de serviço, voluntariamente posicionavam-se nos conveses abertos realizando busca visual. Em alguns momentos, faltavam binóculos para todos os voluntários. Desse modo, um sargento, que acabara de sair de serviço nas máquinas, avistou, na manhã de 6 de junho, o primeiro corpo recolhido.

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[14] Capacidade de operação integrada das Forças Armadas Singulares: Marinha, Exército e Aeronáutica.

[15] Convés mais alto de um navio.

A orientação para que os vigias portassem bastões químicos emissores de luz (cyalume), já desembalados e prontos para o lançamento ao mar em caso de avistamento de quaisquer objetos na água, foi determinante nos recolhimentos noturnos. Seis dos nove corpos recolhidos pela Corveta "Caboclo" foram encontrados durante a noite.

Ao se verificar a destruição do avião A330 da Air France e a inexistência de sobreviventes, os navios receberam a determinação de que fossem localizados e retirados do mar corpos, bagagens e destroços, nessa ordem de prioridade.

As embarcações orgânicas dos navios tiveram fundamental participação nos recolhimentos. A utilização de mais de uma delas, simultaneamente, foi realizada quando os navios identificavam uma grande quantidade de destroços na mesma área. O emprego dos botes conferiu rapidez e facilidade no lançamento e recolhimento, mostrando-se mais eficiente que o uso das lanchas (BRASIL, 2009).

O estabilizador vertical da aeronave, encontrado pela Corveta "Caboclo", foi o maior destroço recolhido. Segundo Sertã (apud TELLES, 2009), Comandante da Fragata "Contituição", a manobra de retirada dessa peça do mar, efetuada por sua tripulação, levou mais de 6 horas e apresentou grande dificuldade, envolvendo cerca de 70 militares. A peça tinha cerca de 14 metros de comprimento e 4,5 metros de largura. Além disso, ela estava cheia de água, o que aumentava o seu peso, e sua superfície era muito lisa, o que dificultava a passagem e a fixação dos cabos para a sua amarração.

De acordo com o sítio[16] de internet da MB, os corpos resgatados foram entregues à Policia Federal e à Secretaria de Defesa Social de Pernambuco para os trabalhos de identificação. Os destroços da aeronave e as bagagens recolhidas foram entregues ao "*Bureau D´Enquêtes et D´Analises Pour la Securité de I´Aviation Civile*"(BEA), órgão responsável pela investigação sobre os fatores que contribuíram para o acidente.

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[16] www.mar.mil.br/hotsites/sala_imprensa/arquivos_PDF/nota_imprensa/notas_2009/notas_airfrance/nota43_260609.pdf

Por conclusão, verifica-se que as tripulações empreenderam um grande esforço na busca, inicialmente de sobreviventes e, posteriormente, de corpos e partes da aeronave. O reforço no serviço de vigilância e a utilização de bastões químicos emissores de luz (cyalume) nos períodos noturnos foram práticas decisivas para a identificação e recolhimento de corpos e destroços. Tudo o que se avistou na superfície do mar foi recolhido pelos navios participantes da operação. O emprego de botes e lanchas orgânicas facilitou o embarque do material encontrado. O trabalho das equipes de mergulhadores, embarcadas nos navios, foi fundamental para o recolhimento de itens específicos, como, por exemplo, o estabilizador vertical.

5 CONCLUSÃO

O Brasil assumiu, junto à comunidade internacional, a responsabilidade SAR sobre uma vasta área marítima no Atlântico Sul, cabendo à MB a condução, de modo tempestivo, das ações necessárias para a salvaguarda da vida humana no mar. Essa área, com aproximadamente 14,8 milhões de km^2, impõe um grande desafio logístico ao planejamento de qualquer operação no seu interior. Como ocorreu nas buscas do SAR SNE 003/09, os esforços coordenados entre a MB e a FAB, com seus meios apoiando-se mutuamente, foram fundamentais para o cumprimento da missão.

Durante o SAR SNE 003/09, a MB enfrentou um vultoso problema logístico ao deslocar e operar 11 navios, alguns deles antigos e com reduzidos raios de ação, com suas aeronaves orgânicas, a grandes distâncias das bases e depósitos navais. O problema foi potencializado pela necessidade de atuação imediata e pelo caráter imprevisto, características intrínsecas de um evento SAR.

O deslocamento de militares com as competências requeridas para tarefas específicas, como as equipes de comunicação social, foi muito importante para a correta condução das ações pela MB. Em eventos SAR de grandes proporções, deve-se considerar a conveniência de que o CCA esteja exclusivamente dedicado à função e que, havendo a colaboração de outros Estados, possua patente equivalente ou superior à dos comandantes dos meios navais estrangeiros, o que propicia a efetiva coordenação brasileira das ações na área de buscas.

Todos os meios da MB podem ser empregados a qualquer momento, inopinadamente, em operações SAR. Portanto, a manutenção do bem-estar e moral elevado das tripulações deve ser uma preocupação constante dos Comandantes das unidades navais, considerando que o desgaste das tripulações contribuirá negativamente no seu desempenho, quando submetidas a situações reais que exijam grande esforço físico e emocional.

Em operações SAR, existe sempre a possibilidade do resgate de corpos no lugar de sobreviventes, motivo de grande frustração para todos os envolvidos. As tripulações que, por dever, efetivamente manusearem cadáveres, podem apresentar distúrbios emocionais. Nesses casos, o embarque de capelães e psicólogos seria desejável, para o atendimento adequado ao pessoal embarcado. Assim, é diminuída a possibilidade de que militares abalados emocionalmente apresentem condutas inadequadas, interferindo nas demais atividades de bordo.

Considerando que os navios distritais foram os primeiros a chegar no local do acidente, cabe-nos a reflexão sobre suas capacidades de atendimento médico diante de um grande número de sobreviventes, provavelmente feridos e debilitados. Esses navios contavam, cada um, com apenas um médico e um enfermeiro. Logo, em situações em que o número de sobreviventes pode ser elevado, os NSD e NSalv devem levar equipes médicas e possuir, previamente estabelecidos, planos de atendimento especial. É determinante, para que seja prestada uma assistência médica de qualidade a eventuais sobreviventes, que um navio de maior porte, com estrutura adequada a cada situação, seja brevemente enviado à área.

A realização das TOM foi determinante para o incremento da permanência dos meios na operação SAR. Visando a possibilitar a execução desses reabastecimentos, todos os NSalv devem possuir a bordo o material próprio para que possam transferir OC aos NSD, assim como ocorre nos meios da Esquadra. Para isso, as comissões de verificação e assessoria ao adestramento da MB, no âmbito distrital, devem cobrar a realização de reabastecimentos no mar nas inspeções dos NSalv e NSD, garantindo a qualidade do material e a correção dos procedimentos. Além disso, nas viagens de rotina, sempre que possível, deve-se efetuar adestramentos de TOM.

Durante o SAR SNE 003/09, verificou-se que os navios não estavam preparados com material necessário para o manuseio de corpos. A fim de mitigar esse problema, seria conveniente que os meios navais possuíssem conjuntos de material para acidentes de grande vulto contendo: roupas descartáveis, luvas de látex, óculos de acrílico, máscaras bloqueadoras de odor e sacos mortuários reforçados. Recomenda-se, ainda, que os DN adotem medidas prévias para que, quando preciso, ocorra o imediato embarque de um contêiner frigorificado nos NSalv, dotando-os de capacidade para armazenamento de corpos. Projetos futuros de navios de grande porte da MB podem contemplar câmaras mortuárias, evitando-se a indesejável utilização das frigoríficas para essa finalidade.

As ilhas oceânicas de Fernando de Noronha e Trindade estão posicionadas no interior da área de responsabilidade SAR brasileira e, de modo inequívoco, podem ser utilizadas no esforço logístico de operações navais futuras. Contudo, ambas carecem da estrutura ideal, que seria equivalente à de uma base aeronaval. Nesse contexto, verificou-se no desastre do voo AF447, que a disponibilidade de um aeródromo no AFN abreviou o atendimento de diversas necessidades logísticas dos meios da MB. Da mesma maneira, a retomada do projeto de construção de uma pista de pouso na ilha da Trindade pode ser decisiva para a solução de problemas logísticos futuros no Atlântico Sul. O Navio Aeródromo "São Paulo" , também, poderia ser empregado em situações semelhantes, no entanto, para que isso seja possível, a MB deveria adquirir aeronaves cargueiras de asa fixa capazes de pousar a bordo.

Finalmente, para possibilitar o suprimento logístico expedito aos meios navais, em qualquer ponto da Amazônia Azul e da área de responsabilidade SAR brasileira, a MB deve desenvolver, em coordenação com a FAB, sistemas de transporte aéreo de suprimentos para navios no mar, similares ao NEACDS e ao *"snowflake"*, o primeiro empregado pela USN desde os anos 1970 e o segundo em desenvolvimento por cientistas estadunidenses.

O incidente SAR do voo AF447 foi um grande desafio para a MB, mas seus marinheiros demonstraram ao Brasil e à comunidade internacional que, apesar das dificuldades inerentes à missão, estão prontos a atender aos chamados da sociedade brasileira, com profissionalismo e dedicação. Cabem, porém, diversas providências para o permanente aprimoramento da logística da MB. Algumas delas foram apontadas neste estudo e podem simplificar, decisivamente, o esforço logístico em futuras operações navais brasileiras.

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ANEXO A – FOTOGRAFIAS DO SAR SNE 003/09

Figura 6 - Corveta “Caboclo” transferindo óleo combustível para o NPa "Grajaú”
Fonte: Marinha do Brasil

Figura 7 - Corveta “Caboclo” transferindo água doce para a Corveta "Jaceguai”
Fonte: Marinha do Brasil

Figura 8 - Helicóptero retirando sobressalentes do RbAM “Triunfo”
Fonte: Marinha do Brasil

Figura 9 - RbAM “Triunfo” transferindo água doce para a Corveta “Jaceguai”
Fonte: Marinha do Brasil

Figura 10 - Militares da Corveta “Caboclo” passando cabos para o recolhimento do estabilizador vertical do airbus, maior destroço encontrado
Fonte: Marinha do Brasil

Figura 11 - Estabilizador vertical a bordo da Fragata “Constituição”
Fonte: Marinha do Brasil

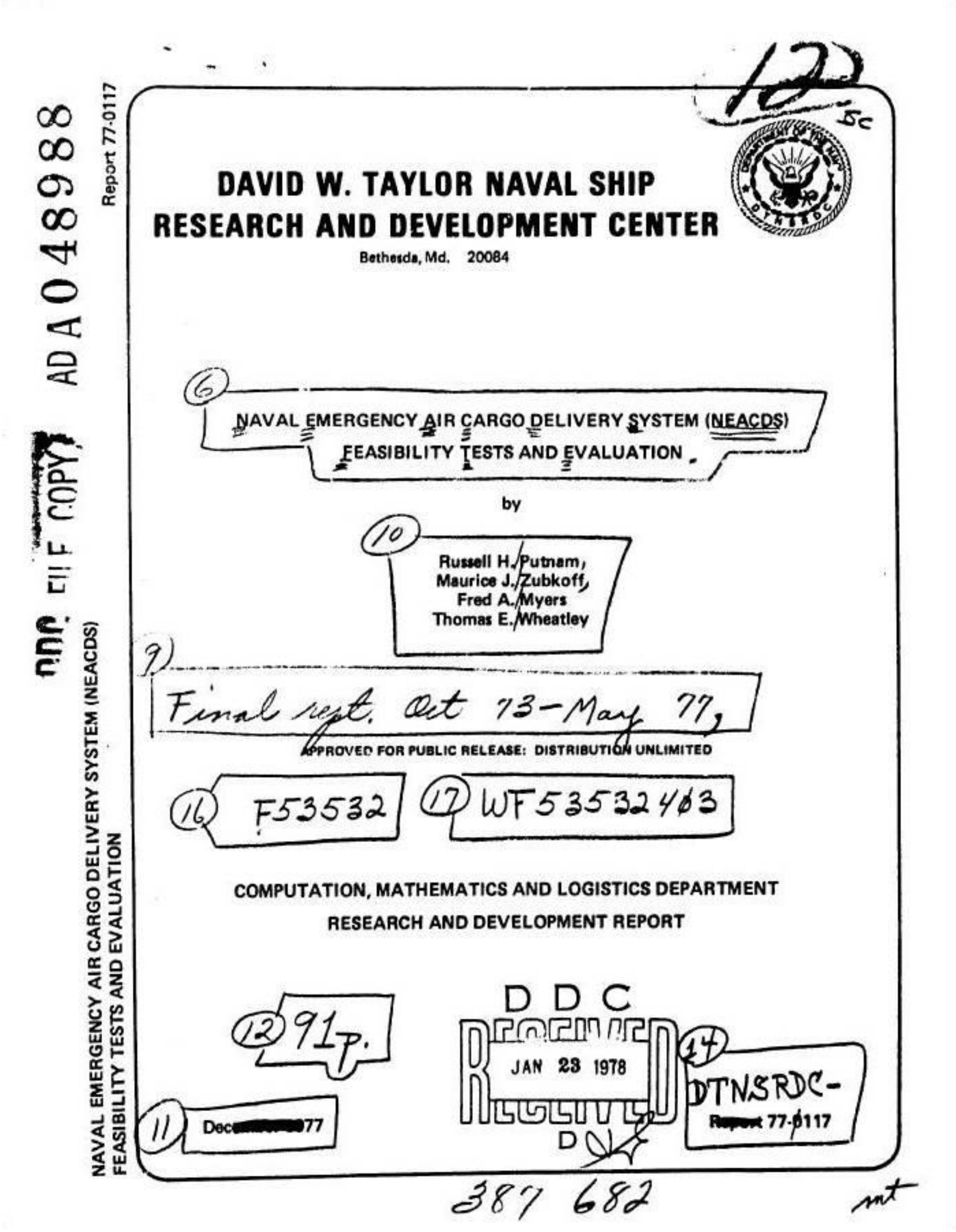
Figura 12 - Mergulhador da Corveta “Caboclo” recolhendo destroço
Fonte: Marinha do Brasil

Figura 13 - Expressiva quantidade de destroços na popa da Corveta “Caboclo”
Fonte: Marinha do Brasil

Figura 14 - NDD “Rio de Janeiro” sendo reabastecido com óleo combustível
Fonte: Marinha do Brasil

Figura 15 – TOM do LHD “Mistral” da Marinha Nacional da França
Fonte: Marinha do Brasil

ANEXO B – *"NAVAL EMERGENCY AIR CARGO DELIVERY SYSTEM (NEACDS) FEASIBILITY TESTS AND EVALUATION"*



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FEASIBILITY TESTS AND EVALUATION

DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER

Bethesda, Md. 20084

(6)

NAVAL EMERGENCY AIR CARGO DELIVERY SYSTEM (NEACDS) FEASIBILITY TESTS AND EVALUATION.

by

(10)

Russell H. Putnam,
Maurice J. Zubkoff,
Fred A. Myers
Thomas E. Wheatley

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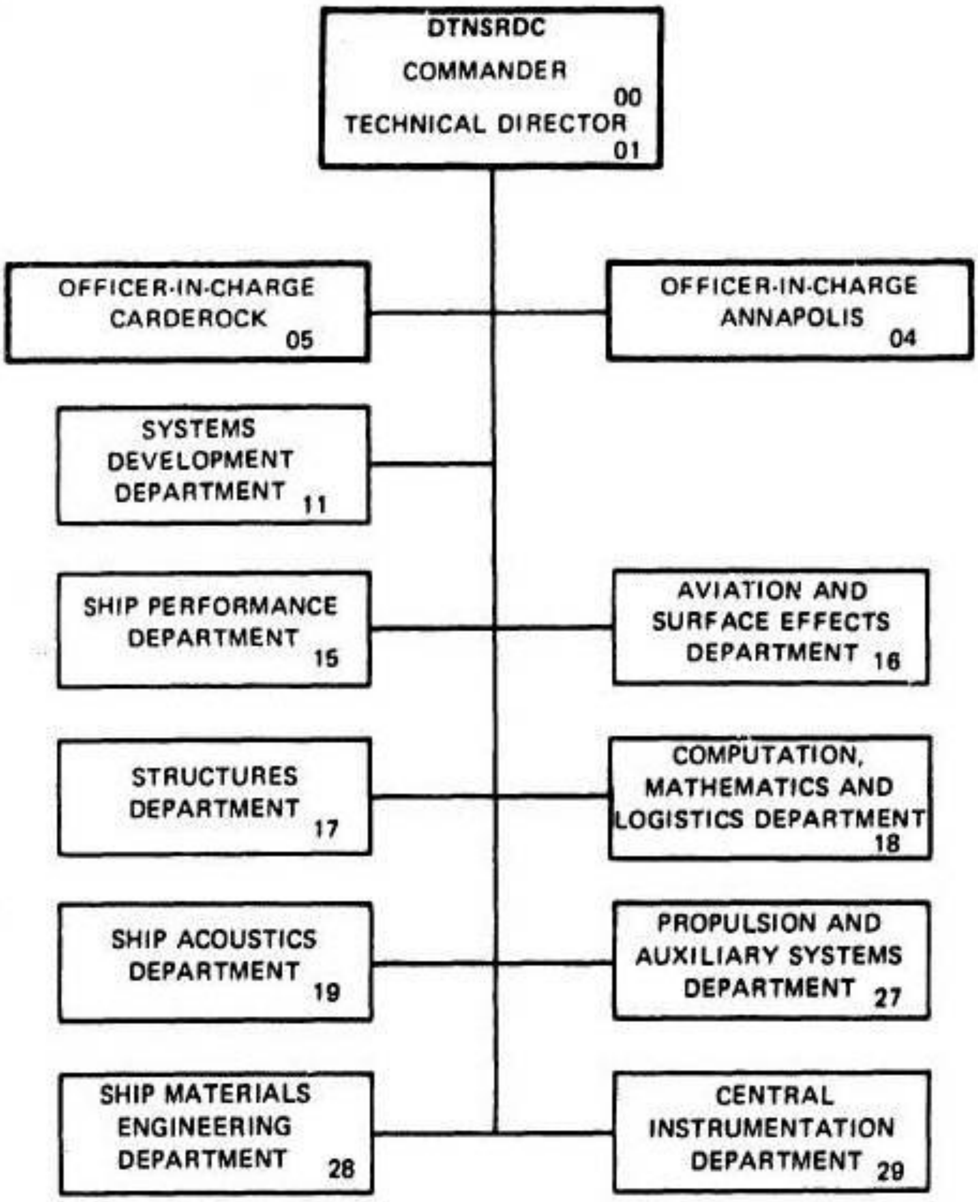

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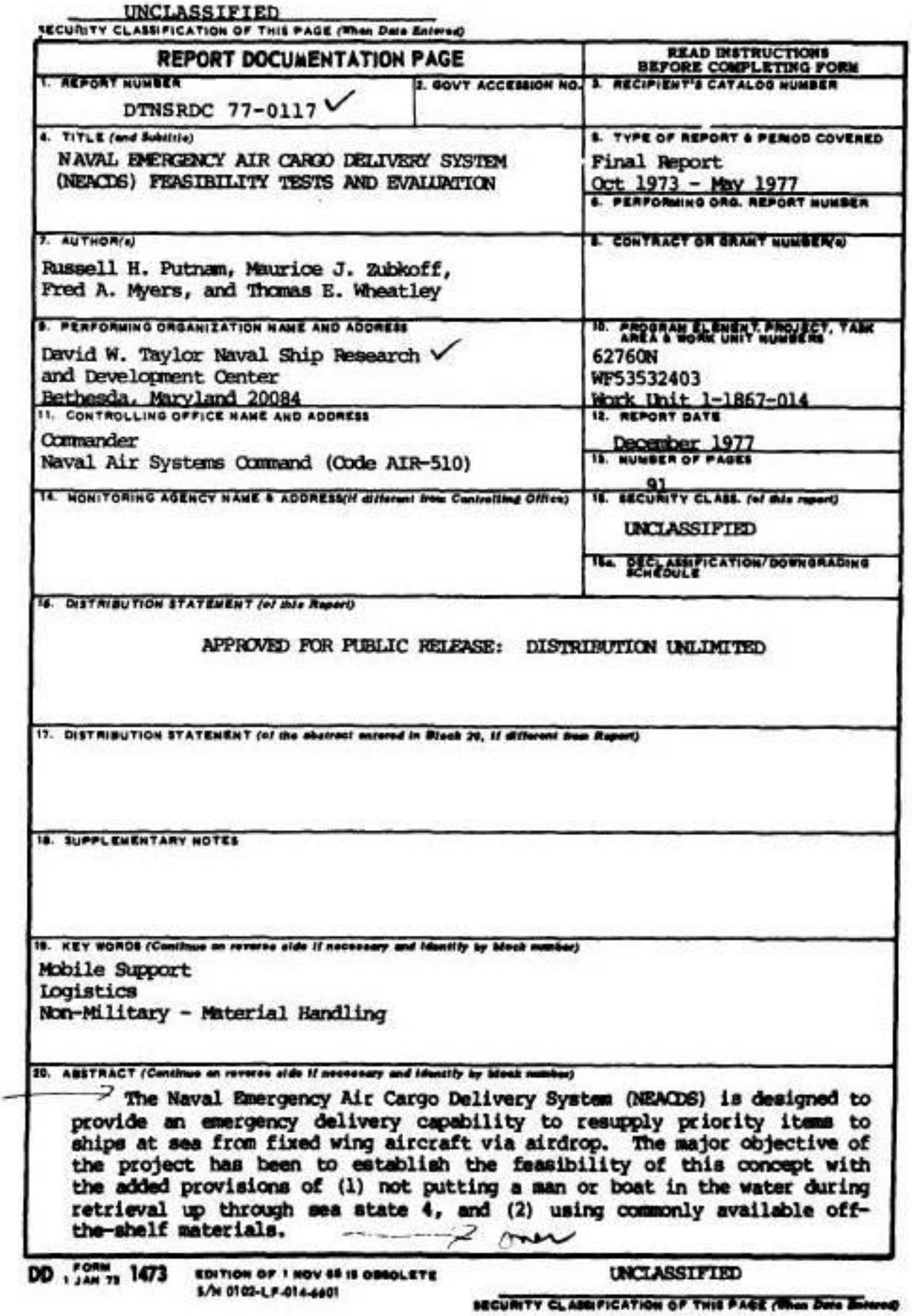

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The Naval Emergency Air Cargo Delivery System (NEACDS) is designed to provide an emergency delivery capability to resupply priority items to ships at sea from fixed wing aircraft via airdrop. The major objective of the project has been to establish the feasibility of this concept with the added provisions of (1) not putting a man or boat in the water during retrieval up through sea state 4, and (2) using commonly available off-the-shelf materials.

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The basic naval problems solved were waterproofing, shock mitigation, load flotation, and retrieval at sea. Coordinating procedures for ship-aircraft operations and communications were developed. The airdrop load categories examined were A-7A loads (100 lb-500 lb; 45.3-226 kg), A-22 loads (500 lb-1600 lb; 226-725 kg), and Heavy Airdrop Platform Loads (3000 lb-18,000 lb; 1360-8164 kg).

The feasibility of NEACDS has been demonstrated and a limited capability is available for use.

This report summarizes the program of static drops, range airdrops and fleet drops for the NEACDS.

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ABSTRACT

The Naval Emergency Air Cargo Delivery System (NEACDS) is designed to provide an emergency delivery capability to resupply priority items to ships at sea from fixed wing aircraft via airdrop. The major objective of the project has been to establish the feasibility of this concept with the added provisions of (1) not putting a man or boat in the water during retrieval up through sea state 4, and (2) using commonly available off-the-shelf materials.

The basic naval problems solved were waterproofing, shock mitigation, load flotation, and retrieval at sea. Coordinating procedures for ship-aircraft operations and communications were developed. The airdrop load categories examined were A-7A loads (100 lb-500 lb; 45.3-226 kg), A-22 loads (500 lb-1600 lb; 226-725 kg), and Heavy Airdrop Platform Loads (3000 lb-18,000 lb; 1360-8164 kg).

The feasibility of NEACDS has been demonstrated and a limited capability is available for use.

This report summarizes the program of static drops, range airdrops and fleet drops for the NEACDS.

SECTION 1
INTRODUCTION

The Naval Emergency Air Cargo Delivery System (NEACDS) is designed to provide an emergency delivery capability to ships at sea from fixed wing aircraft via airdrop. Break-bulk, high priority cargo can be built as single units, as multiple units, or as specially configured platform loads. Missile and ordnance loads can be built in the same way. They can also be airdropped as Heavy Airdrop loads. All loads are compatible with the Air Force 463L Unitized Loading System and are tailored to the retrieval capabilities of the customer ship. This report addresses the several experimental phases conducted to test the concept and establish the feasibility of NEACDS.

SECTION 2

BACKGROUND and APPROACH

The Naval Emergency Air Cargo Delivery System (NEACDS) was conceived in response to a memorandum[1] NAVMAT 04, dated 24 May 1973 concerning CNM Action Sheet 22-73 of 29 March 1973. The Memorandum, subject: "Aerial Delivery of Materials/Supplies at Sea for 6th Fleet Naval Units in the Mediterranean." emphasized "that the system desired was only for small/ light drops." CNM-04 requested that NAVSUP-043 look into the subject. NAVSUP-043 subsequently tasked Code 1867, DTNSRDC, with devising a Feasibility Test plan for an emergency airdrop system. After a short preliminary study during July to October 1973 of then current Army/Air Force Airdrop techniques, Code 1867 submitted a Feasibility Test Plan to develop what was later termed NEACDS. The only guidance given for the development was that the system be compatible with the Air Force 463L Unitized Loading System and that the Modular Container (MODCON) be considered as one type of packaging. The MODCON, although tested under the NEACDS project, was later dropped from further development by DoD. The plan submitted by DTNSRDC was approved by CNM-04 letter, 0412:GWL dated 19 Feb 74[2] appointing CNM-041 (Mr. G.W. Lynn), as Program Manager (PM) and tasking Code 1867, DTNSRDC, as Principal Developing Agency(PDA).

The DTNSRDC Project Plan was based on the 1973 preliminary study of Army/Air Force Airdrop Techniques. This study found that current Army/Air Force procedures, equipment, and training could be used for the airdrop phase. The study defined the Naval problems as water-proofing the loads; providing for shock mitigation of the payload during extraction, main parachute deployment, and splash-down; building buoyancy into the loads so they would float; and developing a means for the customer ship to retrieve the loads in seas through sea state 4 without putting either a man or small boat over the side.

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[1] CNM Memo, 0641:JTC, 24 May 1973, Subj: "Aerial Delivery of Materials/Supplies at Sea for 6th Fleet Units in the Mediterranean."

[2] CNM Letter 0412:GWL, 19 February 1974, Subj: "Request for Work and Resources during Development of the Naval Emergency Air Cargo Delivery System (NEACDS)."

The approach taken was to solve the naval problems within the Army airdrop developmental guidelines modified for the peculiar Navy environment. Static drop tests from a pier crane into calm water were used to develop the water-proofing, shock mitigation, and flotation techniques as well as retrieval ideas and procedures. These tests, conducted with the cooperation of the Navy Cargo Handling and Port Group (NAVCHARPGRU) at Cheatham Annex, VA., were highly encouraging especially since they involved dropping calibrated electronic components. As a second step, airdrops were made under controlled conditions at the NASA Wallops Island Flight Test Center, Wallops Island, VA. and the National Parachute Test Range Salton Sea Facility in California. These airdrops tested the integrity and flotation of the load through extraction from the aircraft, main chute deployment, and splash-down. Retrieval procedures were modified or refined and finally airdrops were made at-sea to Naval Fleet Units during fleet exercises. Details and results of the Static, Range, and At Sea Tests are presented in Section 4 - Tests.

NEACDS Aircraft/Ship Interface Procedures for Airdrop and Retrieval are detailed in a MAC project report.[3]

On 25 March 1974 the PDA submitted a Project Request through the PM to CNO-041 for approval. This request recommended that a CNO project number for a "Departmental Assist, (D/A)" with an "A" priority be assigned to facilitate interfacing with COMOPTEVFOR for planning and participating in anticipated fleet tests. Approval was given and Project Number DV-118A was assigned by CNO letter[4] to NAVMAT-041, dated 10 July 1974. During this period (February to July 1974) static drop tests were successfully completed with A7-A (100-500 lb; 45-226 Kg) and A-22 (500-1600 lb; 226-725 kg) loads at the Norfolk Naval Supply Center (NSC), Cheatham Annex, Williamsburg, VA.

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[3] Kelly, R.K and M.K. O'Day, "Operational Test and Evaluation, Naval Emergency Air Cargo Delivery System Final Report," Military Airlift mand Project 15-5-74, (July 1977).

[4] CNO Letter, SER 983D/189, 10 July 1974, Subj: "Assignment of Proect D/V 118, Development Assist for the Naval Emergency Air Cargo De-Delivery System (NEACDS)."

Range airdrops were planned and made during August and September 1974 at the NASA Flight Test Center, Wallops Island, Va. The Wallops Flight Test Center Range was used under a DoD/NASA agreement to exchange services on a no-cost, non-interference basis in force at the time. The program was conducted on a minimum cost basis by planning to have NEACDS tests included in Marine Corps, Coast Guard, Army and Air Force training programs and field exercises. (During this period, plans were formulated with the assistance of the COMOPTEVFOR Project Officer for NEACDS tests at sea during Fleet Exercises COMTUEX 3-75 and 4-75 to be held during October and November 1974 in the Atlantic Ocean off Mayport, Fla. and the Virginia Capes respectively.)

Two series of tests were made at Wallops Island using dummy loads. The first series consisted of A-7A and A-22 loads weighing from 100 to 1600 pounds (45.3 to 725.7kg); the second, of three heavy platform loads: two approximately 8000 pounds each (3628.7kg), one 19,800 pounds (8981kg). These latter loads were made up of six and ten A-22 modules, respectively. The A-7A and A-22 loads were dropped from a Marine Corps KC-130 aircraft. The heavy airdrop platform loads were dropped from Air Force C-130 and C-141 aircraft.

At-sea tests were made during COMTUEX 3-75 off Mayport in October 1974 to the Frigates USS CONNOLE (FF-1056), USS McDONNELL (FF-1043), and USS PAUL (FF-1080) using dummy A-7A and A-22 loads. Three dummy loads of each category, ballasted with concrete, were built and rigged at NAS Norfolk, VA. by Marine Corps and Air Force personnel, then flown to NAS Jacksonville, Fla., via an Air Force C-130. The airdrop missions were flown from Jacksonville NAS by the Air Force C-130.

The successful results of COMTUEX 3-75 prompted the CNM to direct that "real" loads be dropped to the USS NASHVILLE, LPD-13, off Charleston, S.C., just prior to COMTUEX 4-75. Requests were placed with NAVAIR, NAVSEA and NAVELEX by NAVMAT-04 to provide typical high priority spare parts and components as payload items. Within a week the items were assembled at NAS Norfolk and flown to Ft. Bragg/Pope AFB, N.C., where the NASHVILLE and COMPUTEX 4-75 loads were built, rigged, and staged by Army personnel assisted by Marines from Camp LeJeune, N.C. Two heavy airdrop platform loads consisting of six A-22 modules, each using real items, were made up for the NASHVILLE. These loads weighed approximately 5000 pounds (2267 kg) each on 9 by 12-foot (2.74 by 3.65 m) airdrop platforms. The COMTUEX 4-75 loads dropped to the USS NEW (DD-818) consisted of two A-7A's and two A-22's weighing approximately 200 and 1100 pounds (90.6 and 498kg), respectively.

Upon the retirement of Mr. G. W. Lynn in December 1974, CNM-041 transferred the PDA from DTNSRDC to NAVAIR with Capt. D.C. Carruth, AIR-510, designated the Program Manager. Navy Project Engineering responsibility remained with DTNSRDC, Code 1867. Program sponsorship was transferred from NAVSUP-043 to CNO-041.[5] The new PM was requested to submit a Plan for Action and Milestones (POAM) for CNM review and approval.

On 28 February 1975, the Chief of Naval Material directed the Project Manager to test the feasibility of air dropping missile/ordnance loads and to draw up a plan, with cost estimates, for a 30-day NEACDS resupply of a Carrier Task Group in the Indian Ocean. The Indian Ocean loads were to be built and rigged at Cubi Point Naval Supply Center, P.I., and staged out of Diego Garcia. The resupply mission was to fly west of Diego Garcia on alternate days and airdrop seven tons to a Carrier Task Group. An alternate plan was to stage out of Ascension Island to cover the South East Atlantic and West Coast of Africa. For the alternate plan, loads would have been built, rigged, and staged at an East Coast CONUS Naval Supply Center or on Ascension Island. The drop zone (DZ) was off the West Coast of Africa. (Later, in the summer of 1975, the latter plans were incorporated into the Flexible Deployment Concept for the Second Fleet.)

In March 1975 a list of sixteen candidate missile/ordnance items was forwarded from CNM-04 through NAVSEA-6516 to the Naval Weapons Handling Center (NWHC), Colts Neck, N.J. From this list NWHC Project Engineering Office, Code 8023, selected the following items for test:

1. Standard Arm (AGM-78) in the CNU-183/E Container
2. Shrike (AGM-45) in the CNU-167/E Container

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[5] CNM Memo, 04B/JJG, 16 December 1974. Subj: "Emergency Logistic Support for Surface Vessels; planning assignments for."

3. Mark 46 Torpedo in the Mark 535 Container
4. AN/SSQ-36 (light sonobuoys) and AN/SSQ-50 (heavy sonobuoys) each in a Cylindrical Sonobuoy Launch Container (SLC), packaged within Grey Plastic Overpacks.

From August to mid-September 1975 instrumented static drop tests were made at NWHC to solve the water proofing, shock mitigation, flotation, retrieval, and rigging problems associated with these loads. This work is reported by NWHL[6] and also in Section 4.2.2 of this report. The selected items were all rigged as heavy airdrop platform loads. In anticipation of later requirements for helicopter (CH-46D), rather than ship retrieval, loads 1,2,3, and 4a (light sonobuoys, AN/SSQ-36) were designed to a nominal 5000-pound (226kg) gross weight. Load 4b (heavy sonobuoys, AN/SSQ-50) was approximately 8000 pounds, (3628kg), and was rigged as a "Split 4-Pac", i.e., the load would split into four individual connected pallet loads for ship retrieval. It was estimated that each of these pallets would weigh approximately 1900 pounds (861kg) wet retaining the individual weight within the dynamic lift capabilities of 2100 pounds, (952kg), that frigates and destroyers have with their ASROC or Torpedo Retrieval booms.

Concurrent with the execution of the Missile/Ordnance Static Drop Tests at NWHC, a joint Army, Air Force and Navy airdrop test program for these load was developed and coordinated by DTNSRDC. The loads had to be built and rigged at the Army's Yuma Proving Ground (UPG) Arizona because that facility has the heavy airdrop platform load proof testing mission for loads engineered by NARADCOM. The nearest large body of water, on a test range, convenient to the YPG is the National Parachute Test Ranges (NPTR) Salton Sea facility. Accordingly, arrangements were made with YPG and NPTR as follows:

a. The loads would be built and rigged at YPG under the direction of the NARADCOM and NWHL engineers and technicians who were developing the loads at NWHL. Marine

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[6] "Simulated Air Drops for the Development and Test of Naval Emergency Air Cargo Delivery System Ordnance Loads," Naval Weapons Handling Laboratory Technical Report 7607 (15 May 1976).

riggers from the 2nd Air Delivery Platoon, Camp Lejeune, N.C. would assist YPG Army riggers. The loads would be instrumented with accelerometers and/or strain gages in accrodance with the desires of the cognizant Naval activities supplying the payload items, i.e., Standard Arm and SHRIKE Missiles, Mark-46 Torpedoos, and the AN/SSQ-36/50 sonobuoys. The data would be telemetered from the load to a mobile ground receiving station provided by YPG and parked on the shore of the NPTR Salton Sea area near the drop zone (DZ). The DZ would be 1000 yards (914m) off-shore at approximately 30 feet (9.1m) water depth.

b. Water-borne, shore-side, and chase aircraft photographic coverage would be provided by the NPTR from El Centro, California. The G-11B parachutes and rigging materials from the loads would be recovered and washed at Salton Sea, transported to El Centro, and dried in the NPTR tower. After drying this material would be returned to YPG for inspection and re-use.

c. The Military Airlift Command (MAC) would provide a C-141 Aircraft with air crew to fly the airdrop sorties. The C-141 would fly out of Norton AFB, CA to YPG Laguna Airstrip for loading, to the Salton Sea DZ for the airdrops, and back to Norton AFB.

The coordinated test plan schedule, as executed, was as follows: The loads were built, instrumented, and rigged from 25 October to 13 November 1975. Two loads of each configuration were built for a total of ten loads. The airdrops for each configuration were spaced several days apart to allow for making changes, if necessary, to the second load based on the first loads' performance and its "quick-look" telemetry data. The airdrops were made, two per sortie, one sortie each drop day, on alternate days from the 14 through 25 November 1975. Results of these tests are discussed in Section 4.3.2 of this report.

Since the Missile Ordnance Salton Sea Tests of these Heavy Airdrop loads were successful, at sea trials to Navy Ships were planned. The first series of Airdrops was made out of Charleston AFB, S.C., to the USS FARRAGUT (DDG-37) on 22 March and to the USS CONCORD, (AFS-5), on 23 and 24 March 1977.

The USS FARRAGUT received a "Split Four Pack" of four practice rounds of MK 46 Torpedos, each in a Mark 535 container. Although the total load weighed 4021 pounds (1823kg), each of the four individual loads making up the four-pack weighed less than 1000 pounds (453 kg), well within the ship's lift capacity of 2100 pounds (025kg). Pallet load separation was accomplished by having the ship tow the load a short distance at 4 to 7 knots.

On 23 March the following two NEACDS loads were airdropped to the USS CONCORD:

1) A platform of six inert Shrike Missiles, (AGM-45), weighing approximately 5600 pounds (2540kg)
2) A "Split Four-Pack" of AN/SSQ-41A (heavy) Sonobuoys weighing approximately 5200 pounds (2358 kg). Each of the four pallets in the load had 36 Sonobuoys on it and weighed approximately 1200 pounds (544 Kg). These sub-loads were the size of the largest A-22 loads, i.e., approximately 4 feet (1.2M) cube and could have as easily been retrieved by a DD or FF.

Three more loads were airdropped to the CONCORD on 24 March:

1) A platform of two inert Standard Arm Missiles, (AGM-78), each in a CNU 183/E container, total weight approximately 4500 lbs (2014 kg).
2) A platform of four practice rounds of MK-46 Torpedos, each in a Mark 535 Container, total weight approximately 4200 lbs (1905 kg.)
3) A Four-Pack of live AN/SSQ-41A Sonobuoys weighing approximately 5200 lbs (2358 kg).

The sea states during these airdrops were judged by ship personnel to be two on the 22nd and 23rd and one on the 24th of March. During the eight drops one set of retrieval lines broke due to inadequate fair-leading aboard ship; one load, the SHRIKE, inverted at splashdown; and two sea-painters failed to deploy correctly. However, all loads were retrieved and their contents survived the entire procedure. The torpedoes were fully fueled and no leakage was observed.

The second series of Missile/Ordnance at sea trials took place on 18 and 19 May 1976; drops were made to the USS MILWAUKEE, (AOR-2), during Exercise Solid Shield 76. Though the MILWAUKEE was serving other fleet units, she was not, nor were the NEACDS airdrops, a part of the exercise. This arrangement led to poor communications coordination between the airdrop aircraft, the ship, and the command controlling the exercise airspace.

On the 18th of May a Four Pack of AN/SSQ-41A Sonobuoys weighing approximately 5200 lbs (2358 kg) was dropped in a sea state 3 to the MILWAUKEE. The next day a platform load, approximately 5400 lbs (2449 kg), of two inert Standard Arm, (AGM 78), Missiles was dropped into a sea state of 2-3. Although the sea-painters were fouled and snarled during deployment by the lifting grommet messenger line, the Milwaukee retrieved the loads successfully.

Captains of several of the combatant ships involved in the at-sea airdrops objected to the need for being dead-in-the-water (DIW) during the retrieval process. COMOPTEVFOR also commented that being DIW made the ship both unmaneuverable and vulnerable to any existing threat. One option would be to use the LAMPS helicopters, projected to be onboard many small combatants in the future, as the retrieval instrument. The LAMPS could be launched, proceed to the DZ, retrieve the load, and return to ship. The resupply ships could likewise use their VERTREP helicopters to perform the retrieval.

The feasibility of helicopter retrieval was tested at Camp Lejeune Marine Base, N.C., in July and August 1976. The Rotary Wing Test Branch, Code RW 50, Naval Air Test Center, Patuxent River, Maryland was tasked by Code 5104, NAVAIR, under the direction of DTNSRDC Code 1867, to provide an SH-3G helicopter and air crew to perform a series of retrieval and external load flight envelope tests. A Marine CH-46D helicopter and flight crew were also provided by HMM-264 Squadron, New River MCAS, N.C. Dummy A-7A and A-22 loads ranging from 200 to 1600 lb (90.6 to 725.7 kg) were provided by the Second AD platoon at Camp Lejeune. Two 10-foot (3.0 m) sea-painters, each in the form of a large loop, were attached on opposite sides of each load at its equator. With this configuration one sea-painter was always available for hook-up even when the load was floating on its side or inverted. Either of the load sea-painters could be engaged by a pole-hook assembly handled by a helicopter crewman seated on the steps of the forward personnel door (CH-46D) or in a prone position at the aft cargo door (SH-3G). Both pole-hook assemblies, the 20-foot (6.0 m) quick-disconnect and 15-foot (4.5 m) fixed pole,[7] were successfully used. However, the helicopers had to hover within two to three feet of the water surface, which would not be feasible on any but a calm day with no swell or wave action. During April to June 1977, additional tests were made by the NAVAIRTESTCEN using a floating hook on a long line rig.[8]

The NEACDS development philosophy has been to use off-the-shelf equipment and available knowledge where possible in order to provide all the operational personnel involved with an easily workable system in an emergency environment. This philosophy has been applied from the packaging of the payloads through retrieval. However, in one area, an off-the-shelf item is required to work too far out of its design limits to be highly reliable. This is the light load, 100 to 1600 pound, (45.3 to 725.7 kg) parachute release. The Army has not used parachute releases on loads of these weights for some years. In addition an impact on a "soft surface," i.e., water, is sufficiently different in nature from ground impact to defeat most available mechanisms. To overcome this problem the DTNSRDC funded an effort at the NARADCOM to test and, if necessary, modify an existing design (the M1-A1 Release). This effort is to be completed by September 1977.

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[7] "Naval Emergency Air Cargo Delivery System (NEACDS)", Naval Air Test Center, Patuxent River, RW-62R-76, 7 December 1976.

[8] "Naval Emergency Aircraft Cargo Delivery System Retrieval Devices Feasibility", Naval Air Test Center, Patuxent River, RW-27R-77, 28 July 1977.

SECTION 3
DESCRIPTION OF MATERIALS

3.1 LOAD CATEGORIES

Small loads weighing from 100 to 500 pounds (45.3 to 225.8 kg) are packaged as "Door Bundles" in Army/Air Force A-7A Cargo Bags and rigged with G-14 single parachutes. The number and types of parachutes required to stabilize and retard the descent of the loads depend on the weight of the load. The maximum allowable dimensions of these loads are 36 inches (.91 m) high, 60 inches (1.52 m) long, and 30 inches (.76 m) wide. The parachute will release from the load at water impact. A "sea-painter" is rigged on the load and deployed during load descent to provide a means for securing the load and lifting it onboard ship. The "sea-painter" is either provided with flotation devices or made of three twist polypropylene floating line.

Intermediate weight loads, 500 to 1600 pound (226 to 725 kg), are rigged with Army/Air Force A-22 Cargo Bags, using T-7 (converted), G-12, G-13, or G-14 single or clustered parachutes.

Standard Fiberboard Containers up to pallet size, i.e., approximately 48 inches (1.2m) on each side constructed of corrugated cardboard, are used to package the load. During some of the tests, triwall Paraffin Impregnated Fiberboard Containers (PIFC) were used because they were readily available. However, double-wall corrugated fiberboard containers, more universally obtainable in the Navy Supply System, were later used and found to be equally satisfactory when properly water-proofed inside and out.

Heavy Airdrop loads, 3000 to 18,000 pounds (1360 to 8164 kg) can be built of A-22 units or missile/ordnance loads assembled on Air Force 463L Unitized Load Handling System platforms (Type II) or equivalent. These loads are rigged with single or clusters of G-11A or G-11B parachutes. Floating lines (sea-painters), provided to retrieve the load, also act as tag lines while the load is lifted aboard ship. A lifting grommet, approximately 2 feet (.61m) in diameter, was made by long-splicing a length of line back on itself, forming a stiff loop. The strength of the line was chosen to give a 2.5-3:1 safety factor for each weight load. This safety factor was based on 80% of the original strength of the line.

3.2 PAYLOAD MATERIALS

Table 1 lists the various types of payload materials used during the several tests and airdrops.

3.3 PACKAGING MATERIALS

Special naval environmental requirements for airdrop include shockproofing and waterproofing the payload, and maintaining load buoyancy after splashdown. Many materials were available within the Naval Supply System inventory for packing and packaging NEACDS loads. Payload shock mitigation was achieved using off-the-shelf materials such as rubberized horsehair, cellulose wadding, and pieces of airdrop honeycomb. Commercial cushioning could also have been used.

Foam-in-place resin was tried with limited success. This method of shock mitigation was discarded because of the risk of the expanding, hot foam burning holes in the internal water-proofing bags. The method also was expensive, time-consuming, required specially trained personnel and special equipment.

The A-7A and A-22 NEACDS loads were waterproofed using shrink-wrap bags of 5-mil (.127 mm) polyethylene. However, other 5 to 9-mil (.127 to .228 mm) plastic bags of sufficient size could be used (e.g., commercially available leaf or garbage bags).

3.4 RIGGING MATERIALS

The external configuration for the A-7A unit consists of four sling straps, a plywood skate board, a 60 foot (18.2 m) parachute riser extension with an appropriate size parachute, and a 100-foot (30.4 m) sea-painter. Figure 1 illustrates the external configuration of an A-7A unit. The external configuration of an A-22 unit is shown in Figure 2. An Army standard A-22 cargo bag is wrapped around the fiberboard container and held in place by the accompanying A-22 webbing. If the A-22 units are

TABLE 1 - PAYLOAD MATERIALS

TEST	DATE	LOAD	PAYLOAD	COMMENTS
Cheatham Annex Static Tests	March April, 1974	A-7A, A-22	#10 cans of provisions	A
Wallops Island A-7A and A-22 Airdrops	August, 1974	A-7A, A-22	#10 cans of provisions	A
Wallops Island Heavy Airdrops	October, 1974	Six-Packs A-22	Concrete	B
COMTUEX-3-75	October, 1974	A-7A, A-22	Concrete Canned drinks	C
COMTUEX-4-75	November, 1974	A-7A, A-22	Concrete Canned drinks	C
USS NASHVILLE (LPD-13) Heavy Airdrops	November, 1974	Six-packs A-22	Electronics equipment and parts	D
USS FARRAGUT DGG-37	March, 1975	Four-pack	MK-46 Torpedoes	E
USS CONCORD AFS-5	April, 1975	Platform, Four-pack	SHRIKE Missiles, SSQ-41A Sonobuoys, MK-46 Torpedoes STD ARM Missiles	E
USS MILWAUKEE AOR-2	May, 1975	Platform, Four-pack	SSQ-41A Sonobuoys STD ARM Missiles	E

COMMENTS ON TABLE

A) No. 10 cans of peas, carrots and corn were available from surveyed stock at no cost.

B) Concrete was used for payloads to control load weight.

C) Cases of soft drinks were used as payloads in the A-7A loads.

D) These were representative materials (as supplied by the Naval System Commands) which may be candidates for airdrops to fleet ships. See Tables 8, 9 Section 4.4, for a detailed list of items airdropped.

E) Loads consisted of typical missile/ordnance items

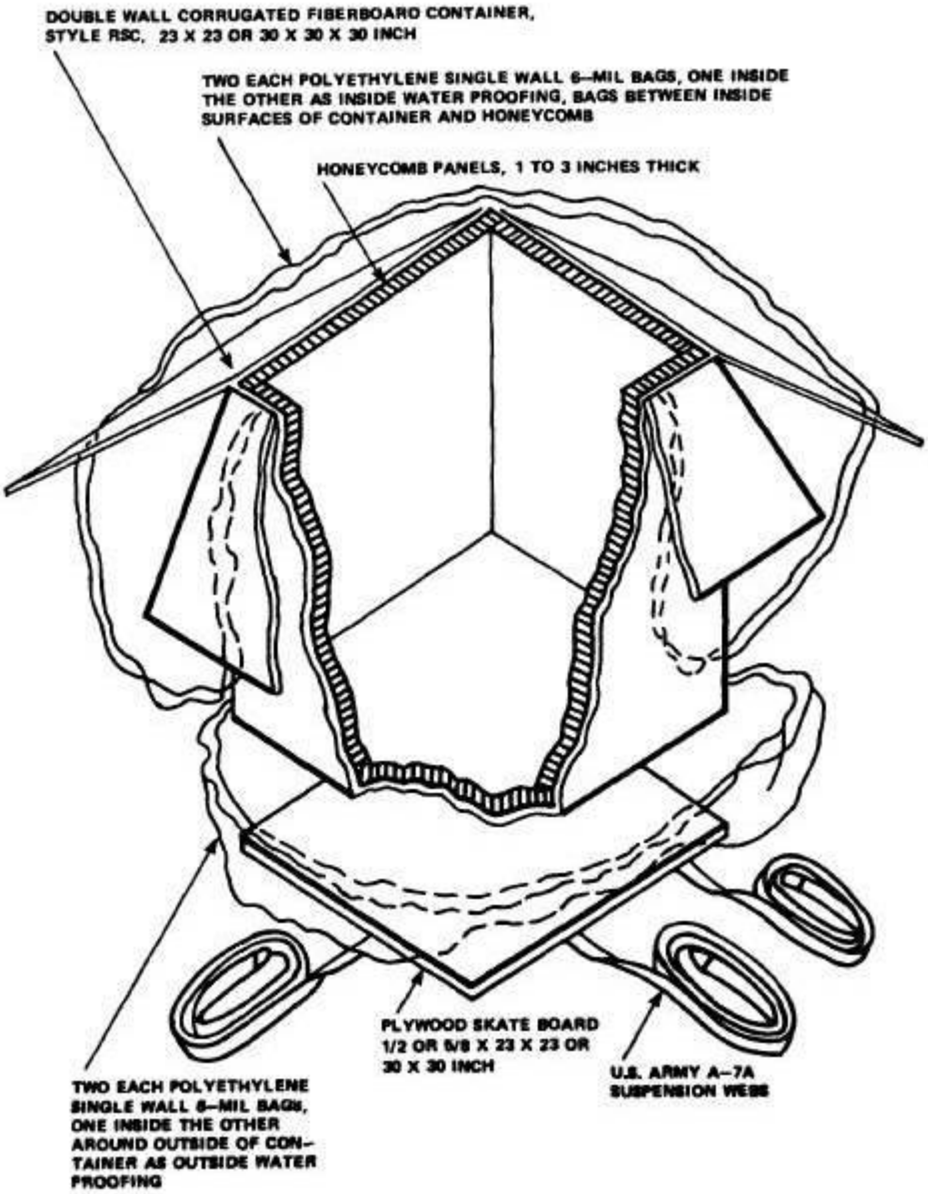

Figure 1 — A-7A Module Schematic

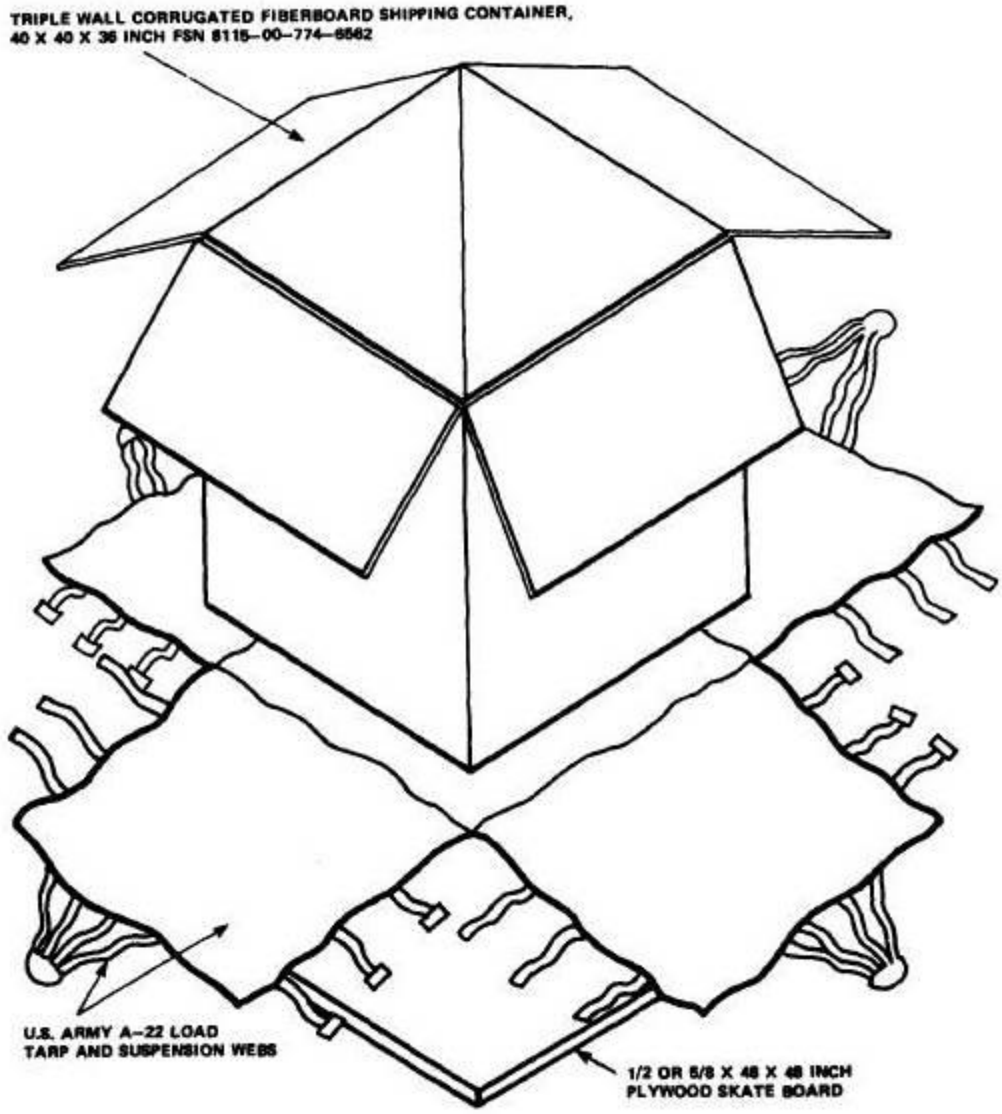

Figure 2 — A-22 Module Schematic

to be airdropped as single loads a skate board constructed of 3/4-in (1.9 cm) plywood is lashed to the bottom. However, the skateboard is not required when the A-22 units are rigged on an airdrop platform for heavy airdrop.

Heavy Airdrop Loads were configured by rigging 4 to 10 A-22 units, or missile/ordnance payloads in their respective containers, on an Air Force 463L Metric or Type II Platform. Standard Airdrop tiedown webbing and load binders were used to lash the payloads to the airdrop platform.

To facilitate load retrieval by the customer ship, sea painters were rigged to each load. Initially, these lines were made of double-braid nylon over a polypropylene core. However, as testing progressed, it was found that three-twist polypropylene line (from GSA stock) was less expensive, more readily available, and easier to handle.

SECTION 4
TESTS AND RESULTS

4.1 TYPES OF TESTS

This section describes the three types of tests conducted in the development of NEACDS, i.e., Static Drops, Range Airdrops, and Fleet Trials. Static Drop Tests were freefall drops from a predetermined height above the water surface to simulate the load impact shock at water entry following a parachute-retarded descent. Range Airdrops were made at instrumented test ranges under controlled conditions to determine load integrity through the sequence of extraction from the aircraft, main parachute deployment, surface impact (splash-down), and load retrieval aboard the customer ship. Fleet trials were airdrops made to Fleet Units under operational conditions at sea.

4.2 STATIC DROPS

Two major series of static drop tests were made: the first used A-7A and A-22 loads at the Norfolk Naval Supply Center, Cheatham Annex, Williamsburg, VA., during March through June 1974; the second series used Missile/Ordnance loads at the Naval Weapons Handling Center, Colts Neck, N.J. from August to mid-September 1975.

4.2.1 Cheatham Annex

The Cheatham static drops were designed to meet the basic environmental requirements of load waterproofing, buoyancy, and shock mitigation on impact with water. Other objectives were to work out retrieval concepts and to develop basic data on load building times and cargo space utilization.

Initial testing was done with two types of containers: The Modular Container (MODCON) and the Paraffin Impregnated Fiberboard Container (PIFC). The MODCON was an aluminum container, 48 in. wide by 40 in. long by 48 in. high (1.2 by 1.01 by 1.2 m). It had a tare weight of 250 pounds (113.4 kg). See Figure 3 for a disassembled MODCON, and Figure 4 for a MODCON rigged for static drop tests.

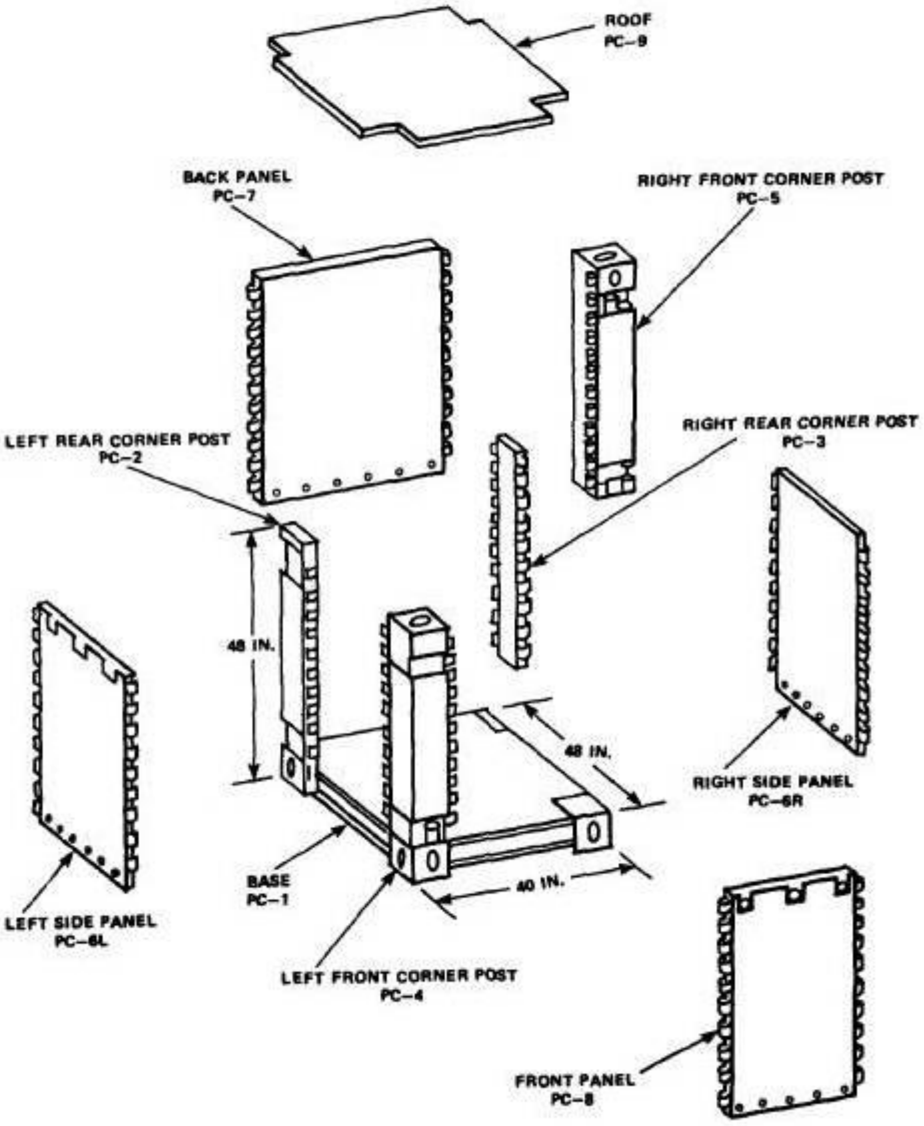

Figure 3 — Exploded View of a MODCON

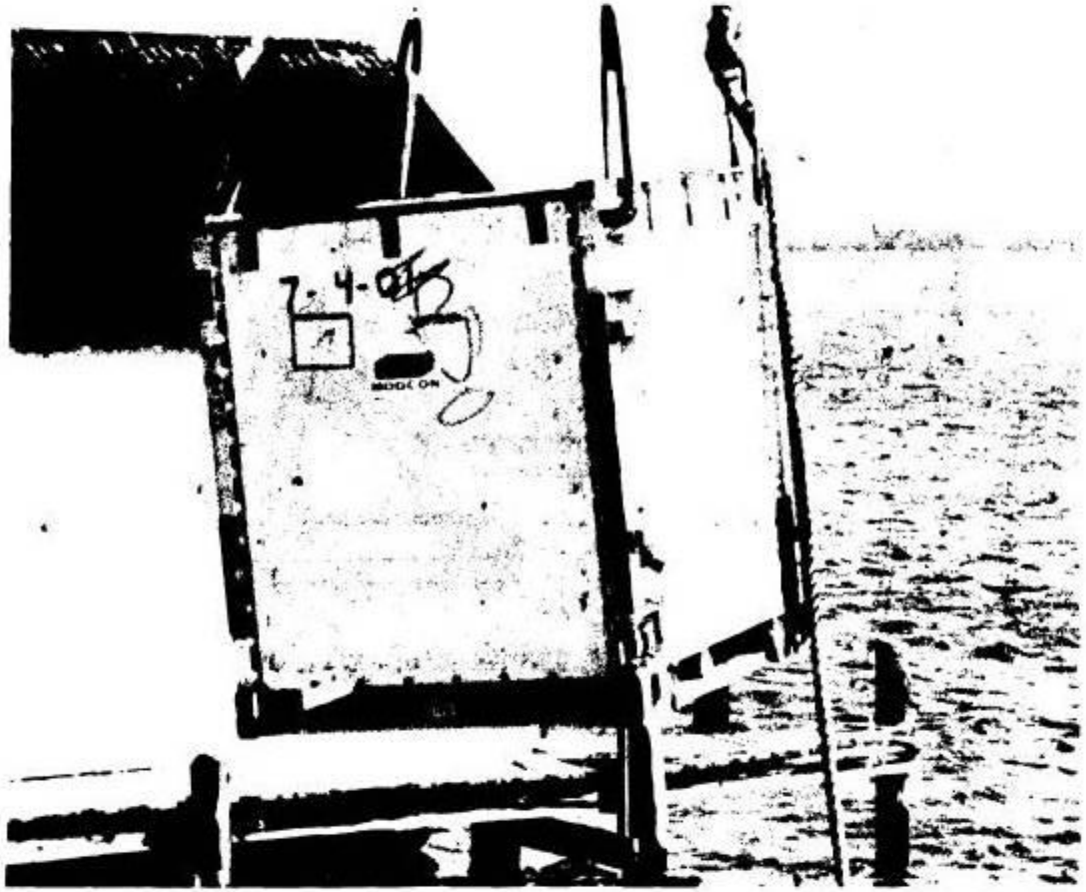

Figure 4 — MODCON Rigged for Static Drop

The PIFC is shown in Figure 5. It is 38 1/4 in. high by 47 1/2 in. long by 39 1/2 in. wide (.97 by 1.2 by 1.0 m) and has a tare weight of 44 pounds (19.9 kg). Because it was paraffin-impregnated, external waterproofing was not required.

During March 1975, waterproofing tests using PIFC were made while awaiting the availability of a MODCON. Loads were built using No. 10 cans of provisions, configured as shown in Figure 6. Initially, a hot glue technique was used to seal the shrink-wrap bags. The original loads used only one shrink-wrap bag as internal waterproofing. The hot glue procedure was time-consuming and required special skills to avoid melting holes in the bag at the seal. Since the shrink-wrap bag is made of a thermosetting plastic, the idea of using heat sealing was investigated. Although this method was somewhat better than the hot glue, it too proved to be time-consuming and required special equipment and skills. Each method of bag-sealing was tested by building loads and float-testing them over-night from the Cheatham Annex pier. Even with successful shrinkwrap bag seals, leaks were discovered in the manufacturers seal. This was solved by double-bagging (i.e., placing one bag within another).

Once waterproofing was achieved, buoyancy was inherent as long as the load weighed less than 64 pounds per cubic foot, (1025 kg/cu.m), the density of sea water.

On these early loads, 1 in. (2.54 cm) thick honeycomb with 1/2 in. (1.7 cm) cells of 60-pound (40 kg) face stock was used to line the inside of the internal waterproofing bags and as separators between the layers of the No. 10 cans of provisions as shown in Figure 6. This lining was necessary to prevent puncture of the waterproofing bags by the payload items.

The first series of static drops was conducted between 1 April 1974 and 10 April 1974 at Cheatham Annex. During this period, four MODCON and ten PIFC drops were made. Each MODCON and PIFC was waterproofed as already described. Several external configurations of each load (MODCON's and PIFC's) were built to assess the use of honeycomb as a shock mitigator,

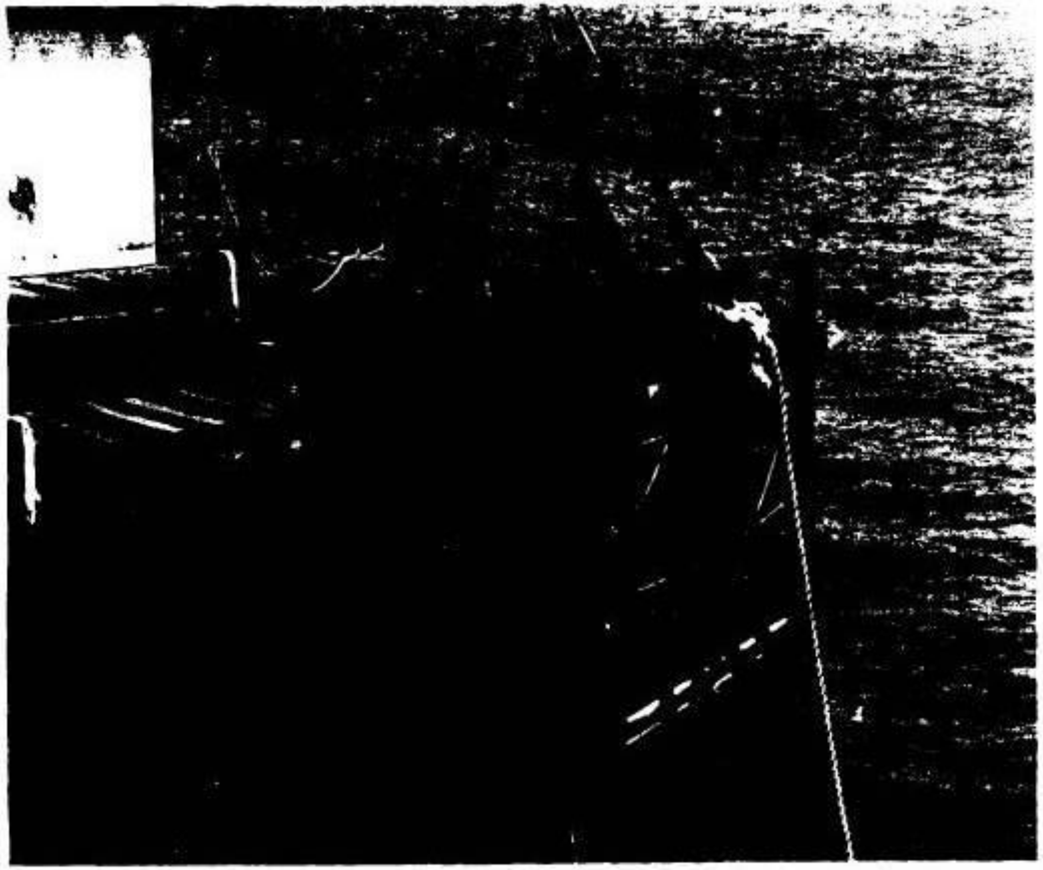

Figure 5 — A-22 PIFC Rigged for Static Drop

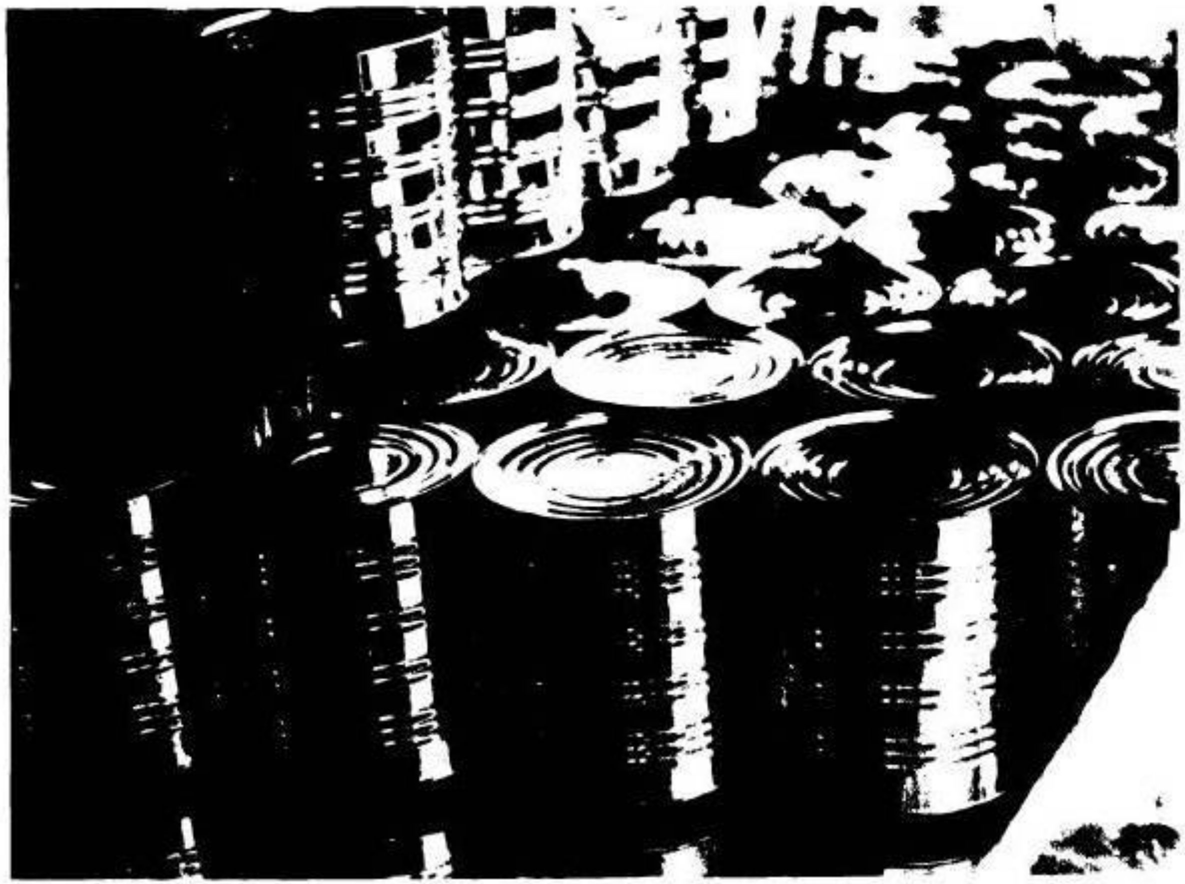

Figure 6 — Internal Configuration of the PIFC

using the Army handbook[9] as a guide. The one-inch honeycomb on hand was much stronger than that used by the Army for airdrop shock mitigation. Though little or no crush was observed, no damage to the payload of cans occurred.

Attempts were made to tighten the loads using foam-in-place resin as cushioning. However, the heat generated during the chemical foaming process melted holes in the plastic waterproofing bags in hidden areas. This problem was discovered when the loads were opened for inspection following the static drop and flotation tests. Scraps of honeycomb or rubberized horsehair were used as cushioning to tighten each load. This solution was less expensive, quicker, and required neither special equipment nor skills.

Efforts were made to reinforce the MODCON bases by inserting 4 by 4-in. (10 by 10 cm) lumber into the fork lift tunnels. Honeycomb was attached to the underside of the MODCON base in an attempt to mitigate the splashdown shock. Despite these efforts, the MODCON base and toggle latches did not survive these static drops. No additional tests of the MODCON were made.

To compare NEACDS PIFC and MODCON loads, the following data, presented in Tables 2,3, and 4, were obtained:

a) Load stuffing time - the time required to fill a container with a payload and 1 in. (2.5 cm) thick honeycomb separators for shock mitigation, assuming that the payload items are stacked near the box and the separators are cut-to-fit.

b) Total payload volume - the sum of the volumes of each payload item (in this case, cans) multiplied by the number of that particular item.

c) External space utilization - the total payload volume divided by the total external volume of the container. This ratio is expressed as a percentage.

d) Soak time - the period of time a load remains in the water after it is dropped.

e) Payload weight - the sum of the weights of the individual payload items.

f) Rigged weight - the sum of the dry weights of the payload, containers, dunnage, and rigging materials (excluding parachutes).

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[9] "Engineering Design Handbook, Design for Air Transport and Airdrop of Material," Headquarters, U.S. Army Material Command, December 1967.

TABLE 2 - MODULAR CONTAINER (MODCON) UTILIZATION RESULTS

LOAD No.	COMMODITY	NO. OF CANS	PAYLOAD WEIGHTS (lb)	TOTAL STUFF TIME (min:sec)	TOTAL COMMODITY (cu ft)	EXTERNAL SPACE UTILIZATION Percent
1	Corn/Peas	188	1454	14:59	21.6	40.5
2	Corn/Peas Potatoes	75 113	580 205	13:39	21.6	40.5
3	Corn/Peas	188	1454	14:03	21.6	40.5
4	Corn/Peas	188	1454	No time recorded	21.6	40.5

1) Crew Size: 3 men

TABLE 3 - PARAFFIN IMPREGNATED FIBERBOARD (PIFC) CONTAINER UTILIZATION RESULTS

LOAD NO.	COMMODITY	NO. OF CANS	PAYLOAD WEIGHT (lb)	TOTAL STUFF TIME (min:sec)	TOTAL COMMODITY VOLUME (cu ft)	EXTERNAL SPACE UTILIZATION Percent
1	Peas Potatoes	89 134	690 243	9:11	25.73	63.7
2	Peas Potatoes	89 134	690 243	9:55	25.73	63.7
3	Peas	223	1729	11:01	25.73	63.7
4	Peas	223	1729	11:02	25.73	63.7
5	Peas Potatoes	89 134	690 243	14.25	25.73	63.7
6	Peas Potatoes	89 134	690 243	No time recorded	25.73	63.7
7	Peas Potatoes	89 134	690 243	9:44	25.73	63.7
8	Peas	223	1729	9:43	25.73	63.7
9	Peas Potatoes	89 134	690 243	No time recorded	25.73	63.7
10	Peas	223	1729	No time recorded	25.73	63.7

TABLE 4 - PIFC AND MODCON STATIC DROP TEST SUMMARY

LOAD NO.	RIGGED WEIGHT (lb)	DROP WEIGHT (ft)	SOAK TIME (min)	EXTERNAL HONEYCOMB CONFIGURATION	REMARKS
1	1206	10	45	2 in. Honeycomb	No leakage
2	1205	10	25	1 in. Honeycomb	Leakage thru hole in bag
3	2025	10	52	2 in. Honeycomb	Some leakage, but not thru seal
4	1991	10	15	1 in. Honeycomb	Some leakage
5	1200	20	15	3 in. Honeycomb	Slight leakage near bottom
6	1223	20	15	3 in. Honeycomb	No leakage in cargo
7	1210	20	20	2 in. Honeycomb	Slight leakage thru seal
8	2008	20	18	2 in. Honeycomb	Leakage thru hole caused by foam heat
9	1210	20	18	1 in. Honeycomb	Double bagged no leakage inside inner bag
10	2010	20	18	0 in. Honeycomb	Double bagged no leakage inside inner bag
1	1990	10	5	3 in. Honeycomb	Leakage thru top seal
2	1320	20	20	3 in. Honeycomb	No leakage or damage
3	2000	20	10	3 in. Honeycomb	Leakage thru hole caused by foam heat
4*	1750	10	-	No honeycomb	Severe leakage; no damage to cargo

* No attempt was made to shockproof or waterproof the load

g) Drop height - distance in feet from the bottom surface of the load to the still water surface, measured vertically.

The remainder of the Cheatham Annex Static Drop Test Series was completed during June 1974. These tests culminated in dropping operational electronic payload items: a SAL 219 Klystron tube borrowed from the Naval Electronic Schools', Norfolk, VA. URN-20 TACAN; and a Magnetron tube borrowed from a SPS-10 radar from a ship at the Norfolk Navy Yard, Portsmouth, VA. In preparation for dropping the Klystron and Magnetron, three instrumented dummy loads representing each real load in size and shape, but of varying weights, were tested.

The objectives of these tests were to determine the degree of splashdown shock mitigation that could be obtained by deeper water penetration, and to obtain a qualitative idea of the shock transmitted to the payload.

The dummy Klystron load was built in a common fiberboard (corrugated cardboard) container measuring 30 by 30 by 30 inches (.76 by .76 by .76 m) to a basic weight of 120 lb (54. kg). Detachable external 60-lb (27.2 kg) weights were added to the bottom of the container to permit variations of the drop weight to 180 and 240 lb (81.6 and 108 kg). The load was dropped successively from five, ten, and twenty feet at the maximum weight (240 lb; 108 kg). The first 60 lb (27.2 kg) weight was then removed and the tests were repeated. Finally, three drops were made at the basic 120 lb (54.4 kg) weight.

A dummy load was also configured for the Magnetron and tested in the same way. Its size was 24 in. long by 17 in. wide by 24 in. high (6.1 by .43 by .61 m). The maximum weight was 194 pounds (88.0 kg) with detachable weights yielding gross weights of 127 and 67 lb (57.6 and 30.4 kg).

Since non-water resistant fiberboard containers were used to build these loads, external (as well as internal) shrink wrap bags were used as waterproofing. These bags protected the container itself and helped maintain its structural integrity during retrieval. This procedure was followed for all subsequent A-7A loads since there were no properly sized PIFC's available.

The instrumentation for each load consisted of an accelerometer mounted at the center of the container and aligned parallel to the vertical axis. The accelerometer signals were transmitted by hardwire to a portable recording station on the pier nearby. Although the actual levels of impact shocks were suspect due to poor mounting of the accelerometer, the relative levels were such that the largest foot-print pressure (lb/sq ft) had the least amount of shock transmitted to the payload.

On the basis of these results, the Klystron and Magnetron were each built into loads weighing 255 and 212 pounds (115 and 96kg) respectively, to get maximum water penetration without giving up too much buoyancy. The Klystron was received prepackaged, nested in rubberized horsehair within an airtight, waterproof metal can 24 inches (.61 m) long by 18 in. (.45 m) in diameter. The sealed metal can was packaged in a 30 inch (.76 m) cube common fiberboard container. The can was laid on its side for best orientation of the Klystron to the splashdown shock. The metal can was cushioned within the container using scraps of honeycomb, as shown in Figure 7. The container was internally and externally waterproofed as an A-7A load.

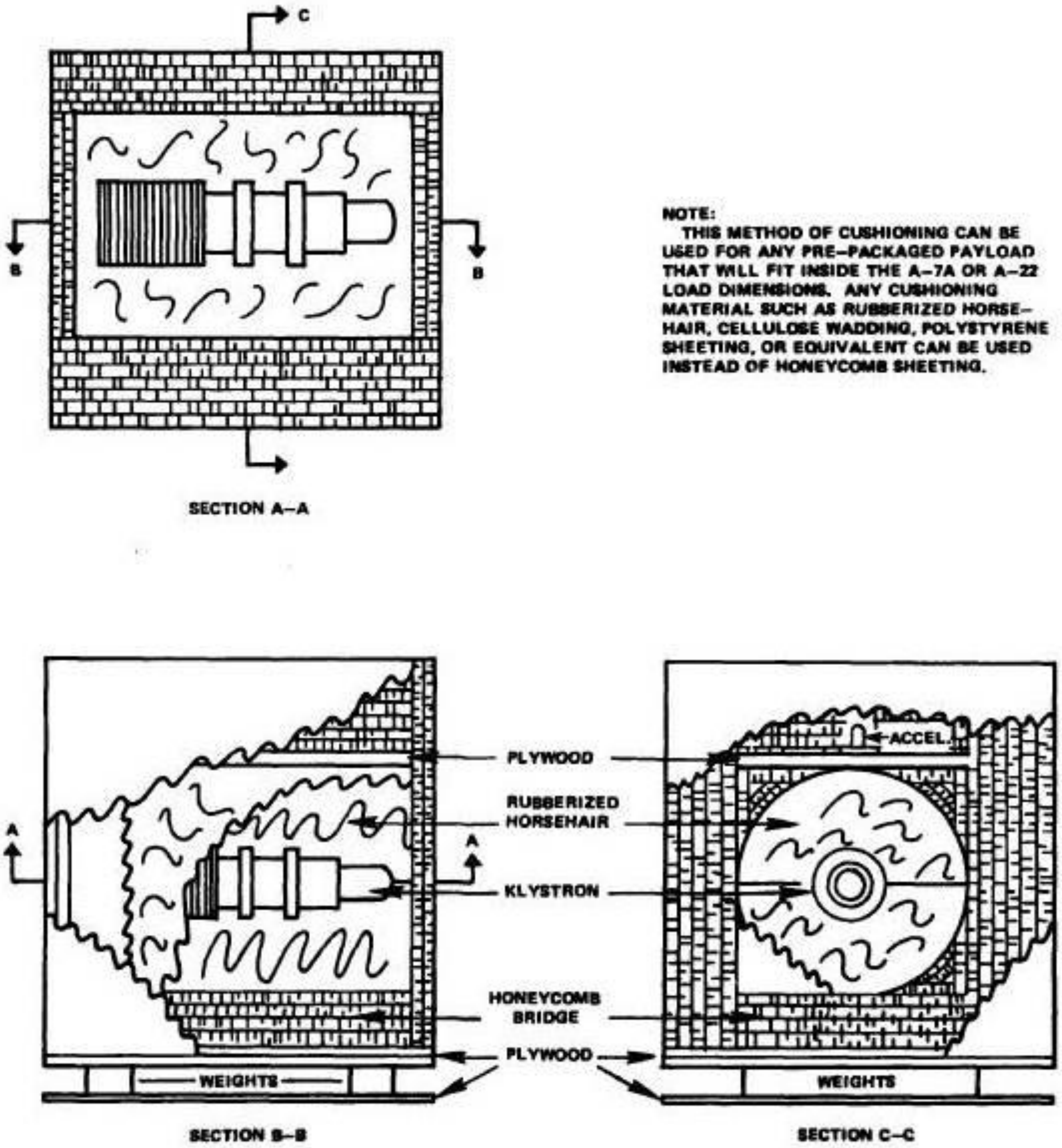
The Magnetron was received packed in a close-fitting styrofoam overpack 13 by 13 by 9 inches (33 by 33 by 22 cm). The Magnetron has a cruciform configuration, the two horizontal arms being opposing magnets and the vertical member the glass electronic tube. The arms were aligned along the diagonals of the overpacks' 13 by 13-inch (33 by 33 cm) face.

The Magnetron was packaged in a 24 by 19 by 24 inch (.61 by .48 by .61 m) box as an A-7A load. Honeycomb layers were built up within the container to align the axis of the glass tube vertically, as shown in Figure 8.

After the drops, both the Klystron and the Magnetron were returned to their cognizant activity for checkout and post calibration. Post drop inspection of these items showed no physical damage and both performed up to their pre-drop calibration values.

4.2.2 Colts Neck

The second major series of static drop tests was made at the Naval Weapons Handling Center (NWHC), Colts Neck, N.J. during August and September 1975. These tests were necessary to design and develop the packaging



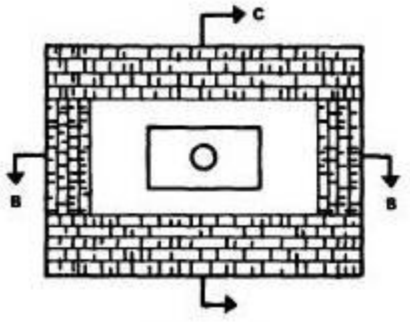
SECTION A–A

NOTE:
THIS METHOD OF CUSHIONING CAN BE USED FOR ANY PRE–PACKAGED PAYLOAD THAT WILL FIT INSIDE THE A–7A OR A–22 LOAD DIMENSIONS. ANY CUSHIONING MATERIAL SUCH AS RUBBERIZED HORSE–HAIR, CELLULOSE WADDING, POLYSTYRENE SHEETING, OR EQUIVALENT CAN BE USED INSTEAD OF HONEYCOMB SHEETING.

SECTION B–B

SECTION C–C

Figure 7 — Schematic of Klystron Packaging



SECTION A–A

NOTE:
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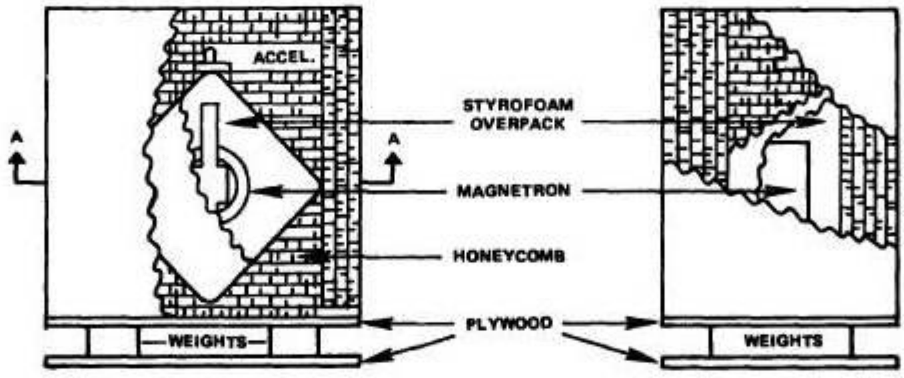


SECTION B–B

SECTION C–C

Figure 8 — Schematic of Magnetron Packaging

and rigging configurations for the NEACDS missile/ordnance loads. The following items were chosen by NWHC as representative types of missile/ordnance container systems:

a) Standard Arm (AGM-78) Missile, one each in a CNU 183/E container

b) SHRIKE (AGM-45) Missile, three each in a CNU 167/E container

c) MK 46 Torpedo (Air Launch), one each in a Mark 535 container

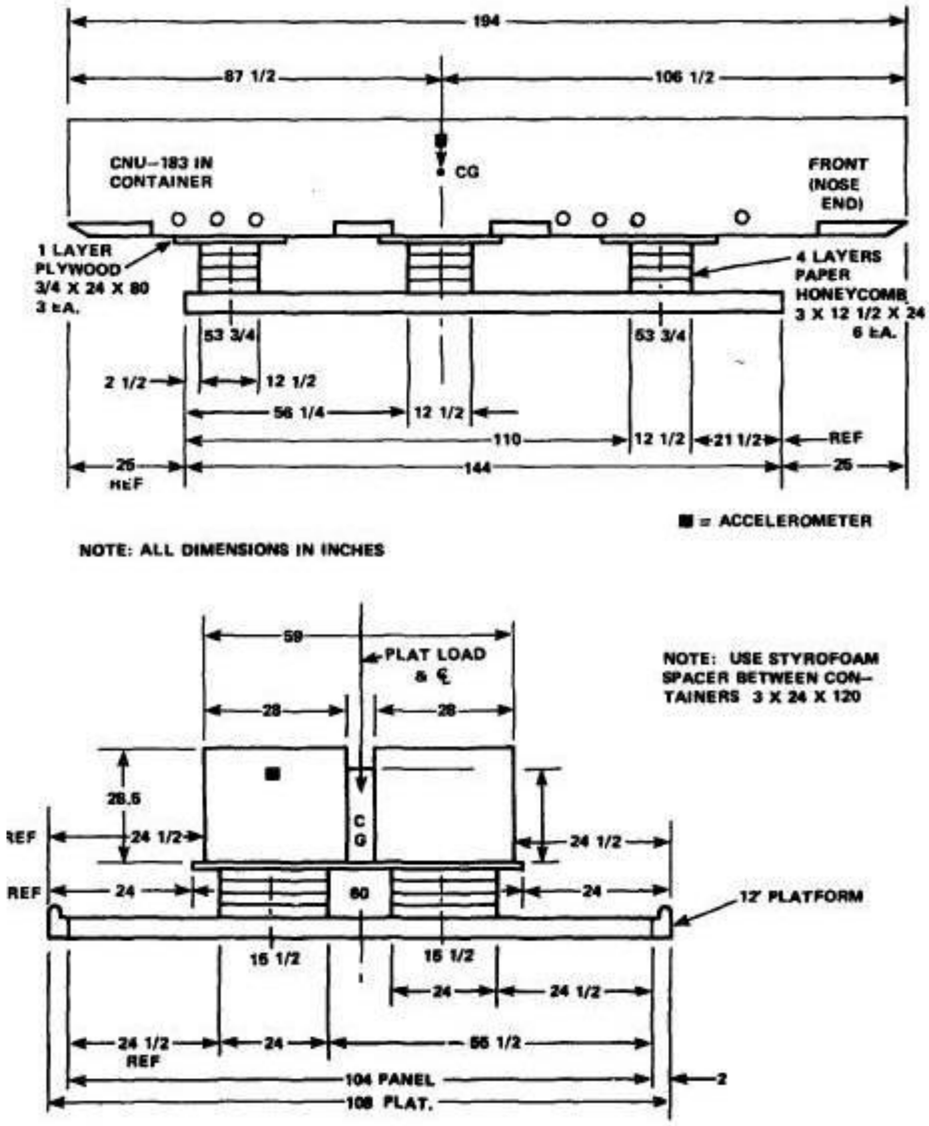
d-g) AN/SSQ-36, 41A, 47B, and An/SSQ-50 Sonobuoys each in a cylindrical sonobuoy launch container (SLC), both in a grey plastic overpack. Thirty six sonobuoys of the same type in the plastic overpacks were strapped vertically on 43 by 43 inch (1.1 by 1.1 m) wooden pallets.

Although each of these containers was ostensibly designed to protect its missile/ordnance item against normal shipping shocks and to remain waterproof, prior NEACDS testing suggested that greater shocks would be experienced during airdrop and impact. Consequently, the experiments were designed around shock mitigation, waterproofing, and retrieval. NWHC engineers and technicians inspected and pressure-tested the various containers to insure their watertight integrity. When necessary, repairs were made to the containers.

The STANDARD ARM and SHRIKE Missiles were each instrumented with a single accelerometer located at the missile's center of gravity (CG). (See Figures 9 and 10 for details.) The sonobuoys were instrumented at the longitudinal center of the airdrop platform and along the vertical axis of the load. The MK 46 Torpedo loads were instrumented at the airdrop platform and at the payloads' CG (See Figures 11 and 12). Data were transmitted by hardwire to an instrument console on the pier. The signal from each accelerometer was recorded from the time of release of the load to shortly after splashdown, with particular attention to the pulse duration (in milliseconds) and the peak value of "G" loading.

Each drop was recorded photographically by the following methods: Still pictures, both 35 mm color and black-and-white prints; a high-speed movie camera (1000 frames/sec); a low-speed movie camera (64 frames/sec); and a video camera with slow motion capability.

Drop heights for each load are shown in Table 5. The drop height determines the speed of impact of the load with the water surface. This speed is equal to the stabilized rate of descent of the load and parachute



■ = ACCELEROMETER

NOTE: ALL DIMENSIONS IN INCHES

NOTE: USE STYROFOAM SPACER BETWEEN CONTAINERS 3 X 24 X 120

Figure 9 — Standard Arm Load Configuration

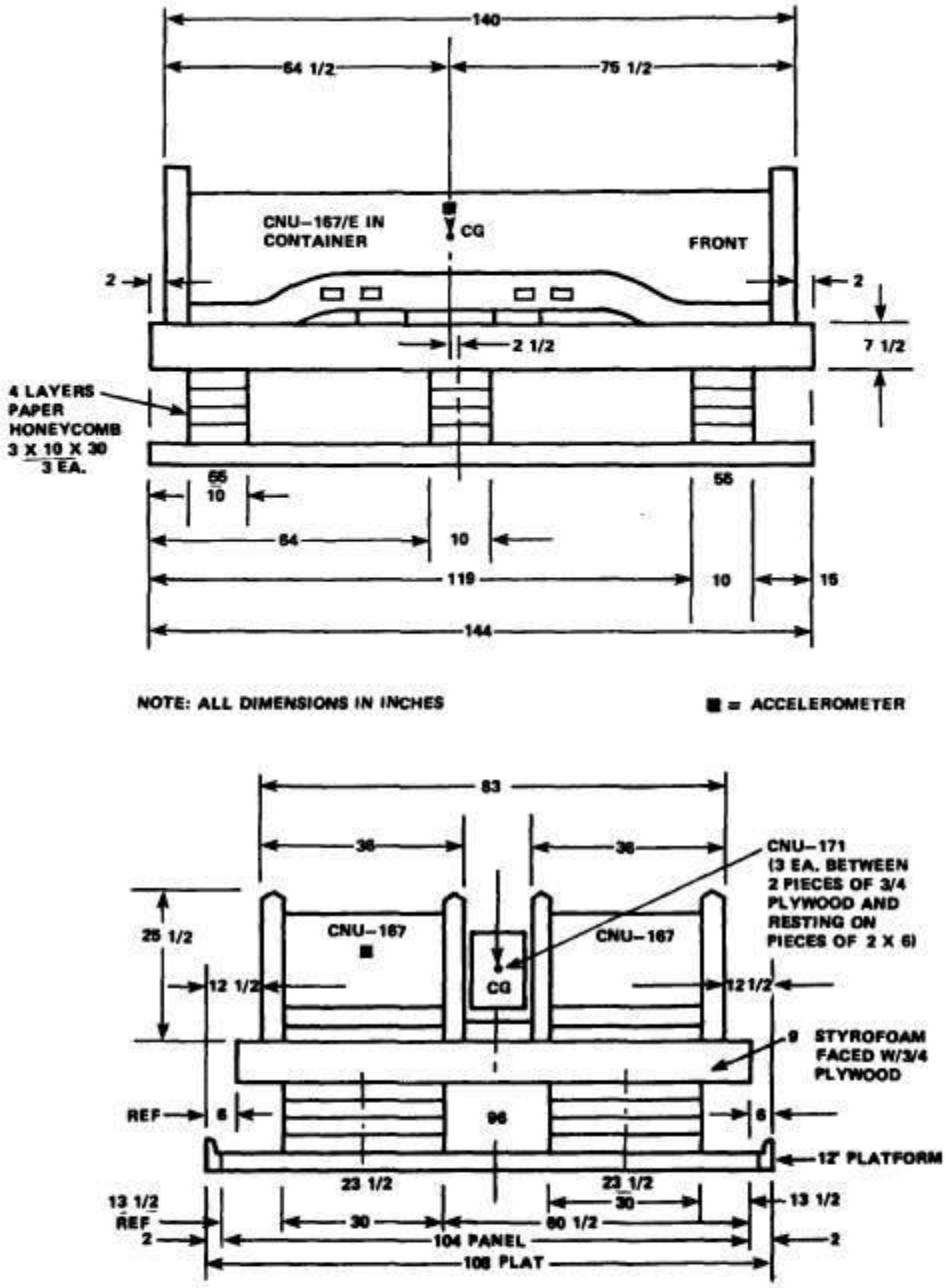
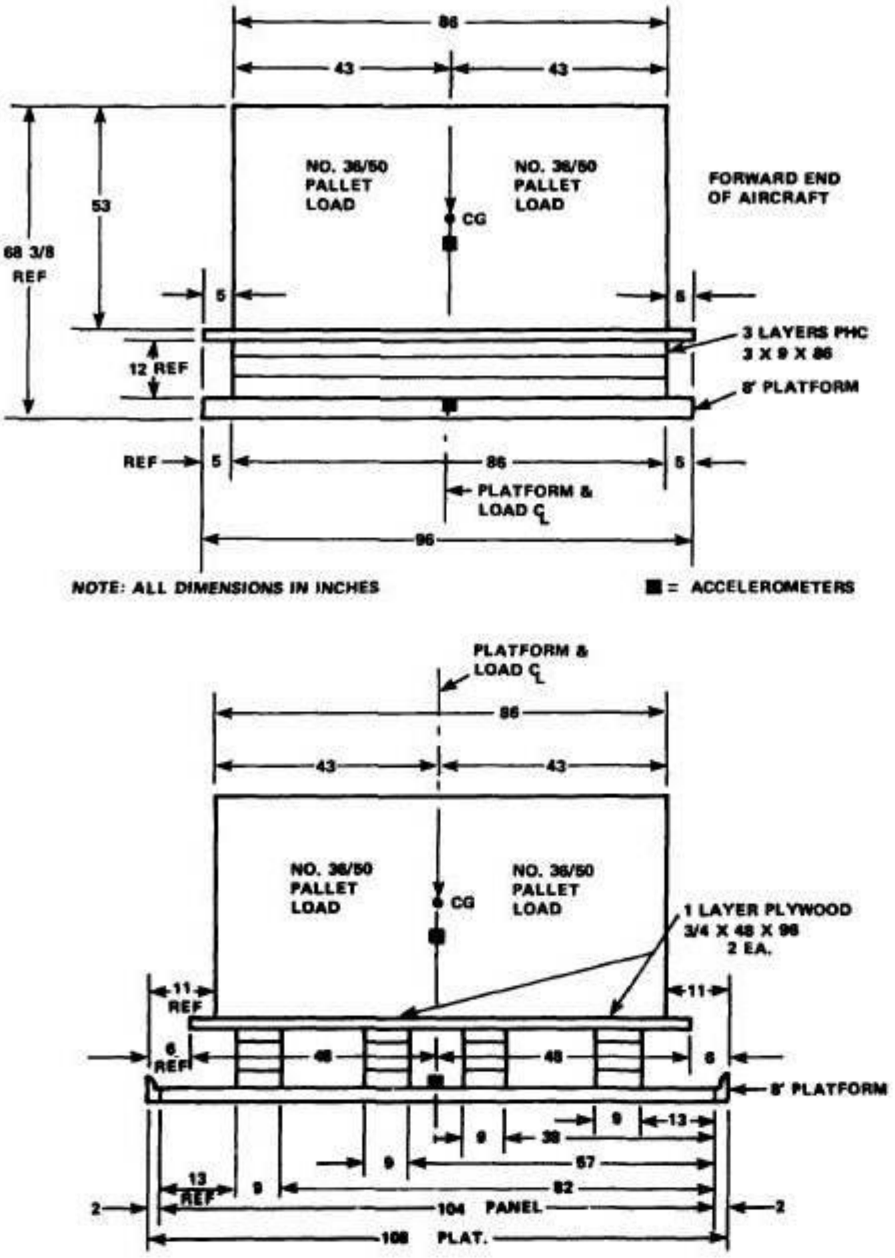


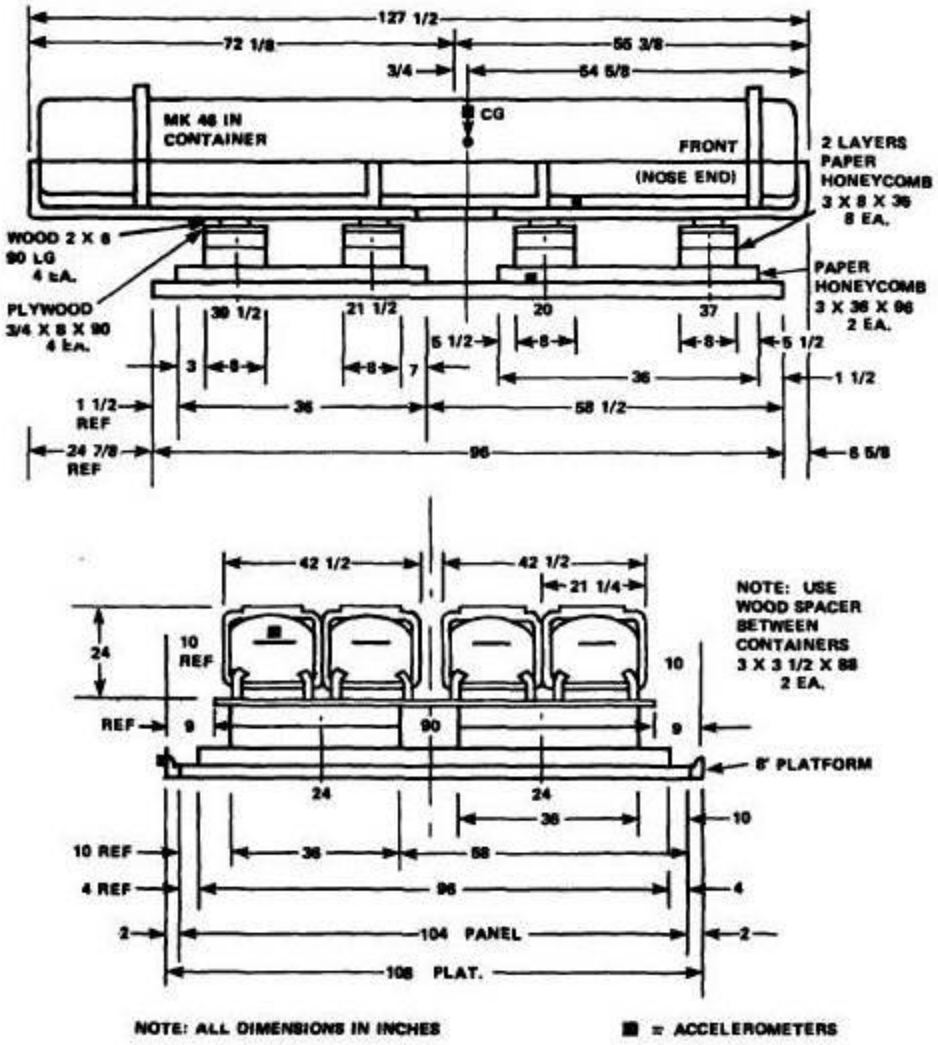
Figure 10 - SHRIKE Load Configuration



NOTE: ALL DIMENSIONS IN INCHES

■ = ACCELEROMETERS

Figure 11 — Sonobuoys Load Configuration



NOTE: ALL DIMENSIONS IN INCHES

■ = ACCELEROMETERS

Figure 12 — MK 46 Torpedo Load Configuration

TABLE 5 - DROP HEIGHTS
AND RESULTING IMPACT VELOCITIES

TYPE OF LOAD	DROP HEIGHT (Ft)	IMPACT VELOCITY (FPS)
Standard Arm MISSILE	12.5	28.5
SHRIKE Missile	12.5	28.5
MK 46 Torpedo	12.0	28.0
Light Sonobuoys	15.75	32.0
Heavy Sonobuoys	13.75	29.09

system. When the load is of sufficient weight to require a cluster of two or more chutes, the rate of descent is taken for a one-chute-not-deployed condition. This is a conservative value, but is realistic in that one chute in the cluster may fail to deploy. If more than one chute fails to deploy, the remaining chutes will not be able to control the rate of descent, and the load will be destroyed.

STANDARD ARM Load:

The NEACDS Standard Arm Missile load was designed for two missiles, each housed in a CNU 183/E container, rigged on a 16 foot (4.8 m) Type II Airdrop Platform. Each missile weighed 1391 pounds (630 kg). Its container weighed 680 pounds, (308 kg) and was 193.5 inches long, 28 inches wide, and 28.5 inches high (4.91 m by .71m by .72m). The 16-foot (4.8 m) platform weighed 600 lb, (272 kg) with an additional 246 lb (111 kg) for rigging, honeycomb, and plywood bringing the total suspended (splashdown) weight to 4988 lb (2262 kg) for load no. 1.

On STD ARM Loads 2 and 3, additional plywood was placed beneath the honeycomb stacks to determine the effect of stiffening the platform. This resulted in a total suspended weight of 5108 and 5092 lb (2316 and 2309 kg) for loads 2 and 3, respectively.

A 12-foot (3.65 m) platform, weighing 450 lb (204 kg) was used on STD ARM Loads 4 through 6 to increase the foot print pressure in an effort to lower the impact shock by permitting greater water penetration. This decreased the weight of the load to 4867 lb (2207 kg) and increased the footprint pressure from 35.5 to 45.0 lb/sq ft (173.3 to 219.7 kg/sq. m).

SHRIKE Loads:

The NEACDS SHRIKE Missile load consisted of six missiles, housed three each in two CNU 167/E containers, with accompanying wings and fins placed in three CNU 171/E containers. Each SHRIKE Missile weighed 407 lb (184 kg) and each 171/E container measuring 18.5 in. long by 9.5 in. wide by 15 in. high (46.8 cm by 24.1 cm by 38.1 cm) and, loaded with wings and fins, weighed 75 lb (34 kg). The CNU 167/E containers weighed 575 lb (260 kg) and measured 140.8 in. long, 36 in. wide, and 25.5 in. high (3.57 m by .91 m by .64 m).

Additional flotation was provided for the load in the form of a plywood and polystyrene sandwich 12 feet long by 8 feet wide by 7 in. high (3.55 m by 2.43 m by .17 m). All six loads were built on 12-foot (3.65 m) platforms, weighing 450 lb (204 kg), with an additional 777 lb (352 kg) for rigging and flotation. This resulted in a total rigged weight of 5044 lb (2287 kg) and a foot print pressure of 46.6 lb/sq ft. (227 kg sq. m).

TORPEDO Loads:

The NEACDS Torpedo ordnance load comprised four torpedos in four MK-535 containers, rigged on an 8-foot (2.43 m) airdrop platform. Each torpedo weighed 541 lb (245 kg). The MK-535 container weighs 280 lb (127 kg) and is 127.5 in. long, 21.3 in. wide and 24 in. high (3.23 m by .54 m by .61 m). The 8-foot (2.43 m) platform, weighing 300 lb (136 kg) plus 250 lb (113 kg) of wood and rigging, brought the total weight to 3914 lb (1775 kg). Again, differing configurations of plywood were tried above and below the honeycomb stacks to stiffen the platform. As a result, the eight torpedo loads ranged in weight from 3914 to 4084 lb (1775 to 1852 kg). The final configuration weighed 4021 lb (1823 kg), yielding a footprint pressure of 55.8 lb/sq ft (227 kg/sq m).

SONOBUOY Load:

The NEACDS Sonobuoy load consisted of four pallets, each with 36 sonobuoys in their launch containers and grey plastic overpacks. The overpacks have an octagonal cross-section of 7 in. (17 cm) across the flats and measured 45 in. high (1.14 m). The sonobuoys were arranged vertically on a 43-in. (1.09 m) square wooden pallet. Loads of both AN/SSQ-36 and AN/SSQ-50 sonobuoys were dropped, the individual sonobuoys weighing 30 and 49 lb (13.6 and 22.2 kg) respectively. Four pallets were rigged on an 8 ft (2.43 m) airdrop platform for a total weight of 5372 lb (2436 kg) for the AN/SSQ-36 sonobuoys and 7948 to 8108 lb (3605 to 3677 kg) for the AN/SSQ-50 sonobuoys, resulting in footprint pressures of 74.6 and 112.6 lb/sq ft, respectively, (364.2 and 549.7 kg/sq m).

The heavy sonobuoy (AN/SSQ-50) platform loads exceeded the 5000-lb (2267 kg) weight limit imposed by the helicopter retrieval requirement. To accommodate retrieval by small ships, i.e., destroyers and frigates, these loads were rigged and tested to split apart into the individual pallets. Splitting was accomplished by towing the load behind the ship at 4-6 knots. After splitting, the pallets formed a string of loads, connected by 100-foot (30.4 m) sea-painters. This allowed the ship to retrieve each load individually, well within it's lift capability. When the first load was brought aboard, the sea-painter for the second was attached, and the retrieval sequence repeated until all loads were on board. Note that the loads still in the water acted as sea-anchors to stabilize the load being retrieved. The last load was stabilized by the platform.

The results of the instrumented missile/ordnance static drop are summarized in Table 6. A detailed discussion for each load design evolution follows.

STANDARD Arm:

The first three loads were rigged on a 16-foot (4.87 m) airdrop platform to protect the payloads to their transportation design limits, defined as a shock pulse represented by an isoceles triangle pulse of 30 g's amplitude and 30 msec duration. The initial design followed standard airdrop calculations[9] for hard (ground) impacts. This design was unsatisfactorily; the missile "bottomed out" and the missile mounting/isolation system (MMIS) of the container deformed causing high "g" loads to be transmitted to the missile. The total honeycomb area was decreased from 2640 sq in. to 1920 sq in. (1.70 to 1.23 sq. m) divided equally among four stacks 12 in. (.30 m) high. This design was predicated on reducing the transmitted "g" level by softening (reduction of area) the shock mitigating material to allow greater stroke. Although the "g's" were reduced on the second drop, the MMIS bottomed and was deformed. For drop number 3, the honeycomb area was decreased to 1800 sq in (1.16 sq m), but was divided equally into three stacks 15 in. (.38 m) high. Since the MMIS bottomed again, a change was made to a 12-foot (3.65 m) platform in an

TABLE 6 - MISSILE/ORDNANCE DROP SUMMARY

				HONEYCOMB CONFIGURATION				ITEM		
TEST ITEM	DATE	DROP NO.	SUSPENDED WT. (LB)	AREA (IN)	STACKS	THICKNESS (IN)	HONEYCOMB DESIGN (G)	G/MS AT CG	CONT G/MS	PLATFORM G/MS
STANDARD ARM	8/8/75	1	4988	2640	4	12	25.93	37.6/ 69	-	-
"	8/8/75	2	5108	1920	4	12	18.58	16.0/ 105	-	-
"	8/12/75	3	5092	1800	3	15	17.24	18.5/ 114	-	-
"	8/15/75	4	4867	1800	6	12	17.24	14.0/ 100	-	-
"	8/19/75	5	4867	1800	6	12	17.24	16.3/ 110	-	-
"	8/19/75	6	4867	1800	6	12	17.24	14.9/ 109	-	-
SHRIKE	8/14/75	1	5044	1800	6	12	16.52	12.4/ 145	-	-
"	8/14/75	2	5044	1800	6	12	16.52	12.3/ 125	-	-
"	8/14/75	3	5044	1800	6	12	16.52	15.7/ 110	-	-
"	8/15/75	4	5044	1980	6	12	18.28	17.5/ 128	-	-
"	8/15/75	5	5044	1800	6	12	16.52	14.7/ 118	-	-

TABLE 6 - (Continued)

TEST ITEM	DATE	DROP NO.	SUSPENDED WT. (LB)	HONEYCOMB CONFIGURATION AREA (IN)	STACKS	THICKNESS (IN)	HONEYCOMB DESIGN (G)	ITEM G/MS AT CG	CONT. G/MS	PLATFORM G/MS
MK 46	8/22/75	1	3914	1728	8	12	20.51	18.0/50	-	190/-
"	8/28/75	2	3998	2160	6	9	25.26	LOAD DROPPED WITH NO DATA		
"	8/28/75	3	3998	2160	6	9	25.26	26.1/75	-	200/13
"	9/9/74	4	4084	2816	4	9	32.45	33.0/75	47.2/23	195/8
"	9/9/75	5	4005	2816	4	9	33.18	38.8/58	54.3/22	194.3/3
"	9/9/75	6	4005	2816	4	9	33.18	36.0/66	-	190.0/13
"	9/18/75	7	3983	2304	8	9	27.13	19.3/90	30.9/0	100/13
"	9/18/75	8	3983	2304	8	9	27.13	17.8/80	-	100/8
AN/SSQ-36 SONOBUOYS (Light)	9/10/75	1	5372	4752	8	9	40.81	72.0/30	-	-
"	9/10/75	2	5372	3060	4	9	25.93	40.2/52	-	215/7
"	9/11/75	3	5372	3060	4	9	25.61	44.6/58	-	150/10
AN/SSQ-50	9/11/75	1	8108	3060	4	9	16.16	15.2/65	-	120/9
"	9/11/75	2	7948	-	-	-	-	79.0/25	-	204/6
"	9/11/75	3	8108	3060	4	9	16.16	17.1/87	-	250/8

effort to achieve greater water penetration. This increased the footprint pressure from approximately 35 lb/sq ft to 45 lb/sq ft (170 to 219 kg/sq. m). Static drops 4, 5, and 6 had the same configuration; 1800 sq in (1.16 sq. m) of honeycomb, divided equally into six stacks 12 inches (.30 m) high on a 12-foot (3.65 m) airdrop platform. As shown in Table 6, this design resulted in an average shock transmitted to the payload of 15 g's.

SHRIKE:

The SHRIKE containers were short enough to rig on a 12-foot (3.65 m) airdrop platform. The resulting footprint pressure was 46.7 lb/sq ft (228 kg/sq. m). The SHRIKE transportation design limits are stated as a half sine wave shock pulse of 25 g's maximum and 30 milliseconds zero-to-zero pulse duration.

The standard airdrop calculations for hard impact resulted in a honeycomb configuration of 1800 sq in. (1.16 s. m) distributed equally into six stacks each 12 in. (.30 m) high. The first and second loads were rigged to splashdown at 10^{o} and 5^{o} inclined to the horizontal respectively. This resulted in the bottoming of the MMIS on each drop, probably because an angular acceleration was induced at the free (high) end by rotation of the load about the low end in the water. All subsequent loads were dropped level to avoid this effect. The third load was dropped level using the same honeyomb configuration, with no damage resulting to either the payload or the MMIS. In the fourth load, the honeycomb area was increased to 1980 sq in (1.38 sq m). Since it had been built before the time of the third drop, it did not benefit from the results of that drop. The fifth and sixth loads had the same configuration as load three; 1800 sq in (1.16 sq m) of honeycomb divided equally into six stacks, 12 in. (.30 m) high. Drops three, five and six averaged 16.1 g's, well below the required design limits

MK 46 TORPEDO:

Four Torpedos in their containers were rigged on an 8-foot (2.43 m) airdrop platform. The MK 46 Torpedo has transportation design limits of a half since wave shock pulse of 60 g's maximum, and a zero-to-zero pulse duration not less than 8 milliseconds. The first load weighed 3914 lb (1775 kg) with a total honeycomb area of 1828 sq in (1.17 sq m) divided equally into two stacks 12 in. (30 m) high. Because there was some damage to the platform, the second and third loads were built using 2160 sq in. (1.39 sq m) of honeycomb divided equally into three stacks 12 inches (.30 m) high, with additional plywood to stiffen up the platform. This brought the total weight up to 3998 lb (1813 kg). Although the platform was undamaged, it was felt that the plywood gave poor load spreader action. In the fourth, fifth, and sixth loads, the honeycomb area was increased to 2816 sq in. (1.81 sq m) divided equally among four stacks 9 in. (22 cm) high. Differing configurations of plywood were tried, but the g loading of the torpedo remained high. The seventh and eight loads were configured as shown in Figure 12. The final configuration weighed 3983 lb (1806 kg) and resulted in an average shock transmitted to the payloads of 18.5 g's.

SONOBUOY Loads:

Both the light (AN/SSQ-36) and heavy (AN/SSQ-50) sonobuoy loads consisted of four pallets on an 8-foot (2.43 m) airdrop platform as already described. The transportation design limits are stated as a half sine wave shock pulse of 100 g's maximum and an 11 millisecond zero-to-zero pulse duration. The first light sonobuoy load weighed 5372 lb (2436 kg) with a total honeycomb area of 4572 sq in. (2.94 sq m) divided equally among eight stacks, 12 in. (.30 m) high. Because the plywood fractured on the first drop, the honeycomb area for second and third loads was reduced to 3060 sq in (1.97 sq. m), divided equally among four strips, 9 in. (22 cm) high. This resulted in an average of 25 g's transmitted to the payload. The first heavy sonobuoy load weighed 8108 lb (3677 kg) and again used 3060 sq in (1.97 sq m) of honeycomb, but the area was divided among six strips 9 in. (22 cm) high. No damage occurred to either the platform or the payload. No honeycomb was used on the second load. Although the load survived, it was felt that the shock level was excessively high. The third load was made identical to the first to confirm results. This final configuration resulted in an average shock transmitted to the payload of 16 g's.

4.3 RANGE AIR DROPS

Two series of range airdrops were conducted during the NEACDS program: testing of the A-7A, A-22, and Heavy Airdrop loads at Wallops Island, Virginia during August and October 1974; and testing of the missile/ordnance loads at the Yuma Proving Grounds/NPTR Salton Sea Facility near El Centro, CA. luring November 1975. The major goals of these tests were to examine load airdrop characteristics, sea-painter deployment, and retrieval aspects of delivering a payload in a simulated open sea environment under "controlled conditions."

4.3.1 Wallops Island

The first series of airdrops was accomplished with the assistance of the National Aeronautics and Space Administration (NASA) at their Wallops Flight Center, Wallops Island, Virginia. Eight A-7A door bundle loads, nine A-22 loads and four Heavy Airdrop loads were tested. This series involved a joint service effort of Navy, Air Force, Marine Corps, and Coast Guard as well as NASA resources personnel and assets.

Three separate test drop days were established for the A-7A door bundles and A-22 unit loads. Payloads for the A-7A loads consisted of lead weights; those of the A-22 loads were No. 10 cans of provisions similar to those used in the static drop test series. On the first drop day, three each of A-7A and A-22 loads were airdropped from a Marine Corps KC-130 airplane. On the second drop day six more loads, three A-7A and A-22 loads, were tested. On the third day two additional A-7A loads and three A-22 units were airdropped. NASA provided both standard and high speed motion picture coverage as well as radar tracking for load ballistic data. The A-7A and A-22 loads were retrieved using a 24-foot (7.3 m) Coast Guard boat or a 32-foot (9.7 m) commercial fishing boat. Due to it's limited lift capability, the Coast Guard boat towed the A-22 loads back to the dock, a distance of 5 miles (8.04 km) at a speed of 5-6 knots.

The A-7A Door Bundles were rigged in accordance with current Army/Air Force procedures for jungle terrain drops.[10] On these early loads, the

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[10] "Airdrop of Supplies and Equipment: Rigging Containers," Departments of the Army and the Air Force, Army TM 10-500-1/Air Force TO 13C7-1-11 (February 1972).

sea painter also served as a 100-ft (30.4 m) riser extension. The sea painter line was double braid nylon over a polypropylene core floating line. The riser extensions ensured that the parachute would be released high enough above the water surface to be blown out of the retrieval area. One-half of a Two Jaw ground release was attached at the top of the riser extension/sea painter. Later airdrops separated these functions, using standard nylon riser extensions and rigging the sea painter in an accordian fold along the front side of the load as it is placed in the aircraft. (See Figure 13 for a typical A-7A load.)

The A-22 loads were first rigged similarily, using a 150-foot (45.7 m) 3/4-in. (1.9 cm) diameter line as the riser extension/sea painter. An A-22 cargo bag with its accompanying scuff pad and webbing was used to house the container and payload. (See Figure 14 for a typical A-22 rigged for airdrop.) Again, as for the A-7A loads, the functions of riser extension and sea-painter were later separated. By so doing, the load rigging became more compatible with current airdrop procedures; the sea-painter line could be lighter, less expensive, and more easily obtained. The later sea-painters were made of three-twist polypropylene floating line.

Retrieval techniques for these loads (A-7A and A-22) involved heaving a grapnel line to capture the floating sea-painter; retrieving the sea-painter and bringing it aboard ship; and lifting the load aboard using the sea-painter as a lifting line reeved through a block on a torpedo recovery (or ASROC) boom.

Shock mitigation on these loads utilized the foam-in-place resin and 1 in. (2.54 cm) honeycomb. Four A-7A door bundles and four A-22 loads were equipped with onboard telemetry units in an attempt to measure the shock at the payload during extraction, main parachute deployment, and splash-down. Results of this test are suspect because of discrepancies between pre-and post-calibration tests of the telemetry units. Although special consideration was given to mounting the units inside the loads, vibration of these units could have caused excessively high shock forces to be sensed by the accelerometer.

Figure 13 - A-7A Load Ready for Parachute Attachment

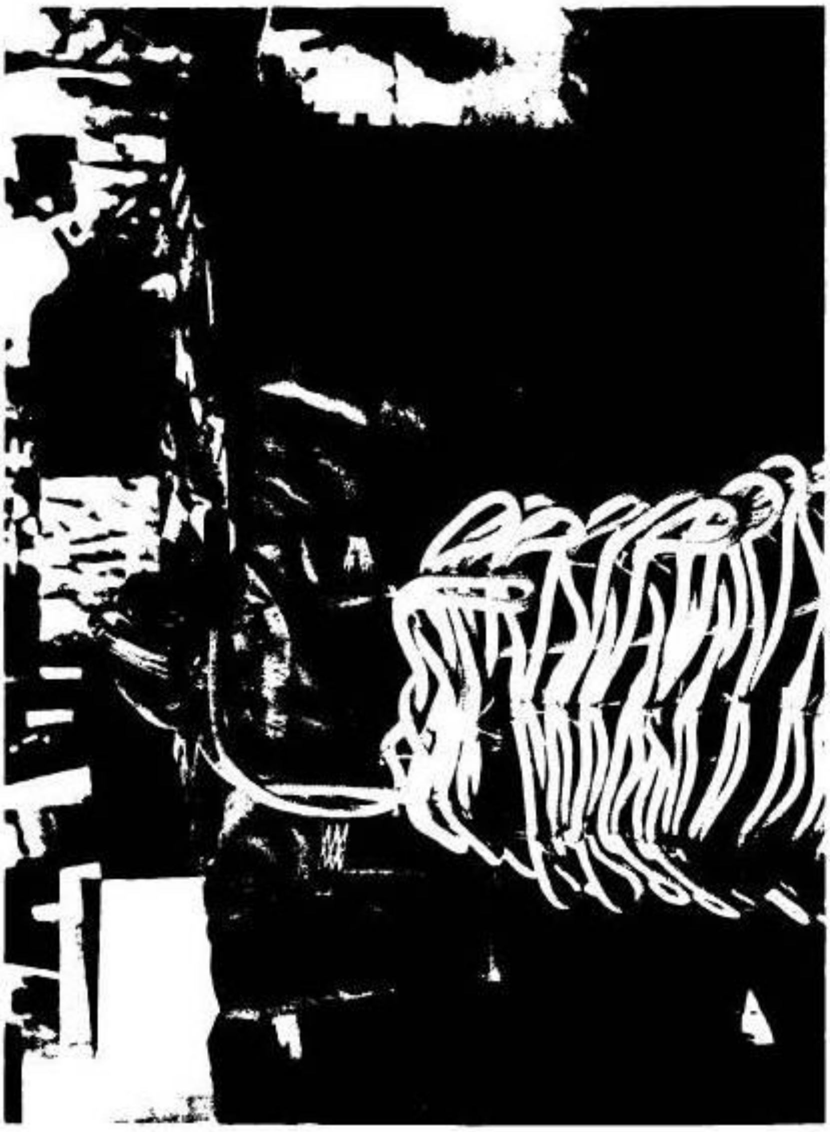

Figure 14 -- A-22 Load Ready for Parachute Attachment

On 19 August 1974, the first drop day, three A-7A loads and three A-22 units were dropped. Five of these loads were airdropped and retrieved satisfactorily, but the parachute on the 300 lb (136 kg) load failed to deploy and the load broke apart on impact. On the second drop day, 21 August 1974, three more A-7A and three more A-22 units were airdropped. All the parachutes deployed properly. All loads were retrieved without incident, although on load No. 12, a 1600-lb (1725 kg) A-22 unit, the 64-foot (19.5 m) diameter parachute failed to release at impact. The sea painter was cut at the parachute release and the load was retrieved satisfactorily. The final drop day for the single unit loads occurred on 23 August 1974. Two A-7A units and three A-22 units were dropped and retrieved satisfactorily. All loads airdropped remained watertight.

The Wallops Island A-7A and A-22 unit airdrops are summarized in Table 7. Prior to the drops, a sample of three A-22 units was selected and the cargo bag and sea painter rigging times were recorded. Results indicated that the A-22 cargo bag rigging time averaged 22 min, 36 sec, and the sea painter rigging time averaged 27 min, 24 sec. The total average time to completely rig an A-22 unit for airdrop was 50 min, 09 sec. An A-7A unit would require less time; platform airdrop loads would require considerably more time.

The aircraft tactics and ship maneuvers for these drop tests were established well in advance of the actual operation. An attempt was made to simulate the at-sea procedures to be used during fleet exercises. The aircraft proceeded to the target area under Instrument Flight Rules (IFR) at cruise altitude as required, descended to a drop altitude when over the drop zone, and flew a racetrack pattern around the ship until the final clearance for drop was given by the ship. Turning inbound on the airdrop leg, the aircraft established the required lateral offset of 1000 yd (.91 km) abeam of the ship and navigated to the Computed Air Release Point (CARP) to obtain a point of impact (PI) 1000 yd (.91 km) forward of the ship's bow. The aircraft repeated the above procedure for each load. Figure 15 shows the flight and retrieval pattern used during the Wallops Island airdrop tests. The aircraft altitude varied between 1000 and 1400

TABLE 7 - WALLOPS ISLAND A-7A and A-22 LOAD SUMMARY

	TEST DATE	TYPE OF LOAD	RIGGED WEIGHT (LB)	CARGO BAG RIGGING TIME (MIN:SEC)	SEA PAINTER RIGGING TIME (MIN:SEC)	TOTAL RIGGING TIME (MIN:SEC)	CREW SIZE
1	8/19/74	A-7A	130	-	-	-	-
2	8/19/74	A-7A	207	-	-	-	-
3	8/19/74	A-7A	306	-	-	-	-
4	8/19/74	A-22	503	-	-	-	-
5	8/19/74	A-22	1015	-	-	43:33	4
6	8/19/74	A-22	1596	-	-	-	-
7	8/21/74	A-7A	205	-	-	-	-
8	8/21/74	A-7A	301	-	-	-	-
9	8/21/74	A-7A	130	-	-	-	-
10	8/21/74	A-22	596	-	-	-	-
11	8/21/74	A-22	992	-	-	-	-
12	8/21/74	A-22	1604	-	-	-	-
13	8/23/74	A-7A	204	-	-	-	-
14	8/23/74	A-7A	302	-	-	-	-
15	8/23/74	A-22	599	26:36	22:18	48:54	2-3
16	8/23/74	A-22	932	22:15	28:32	50:47	2-3
17	8/23/74	A-22	1582	19:17	31:28	50:47	3

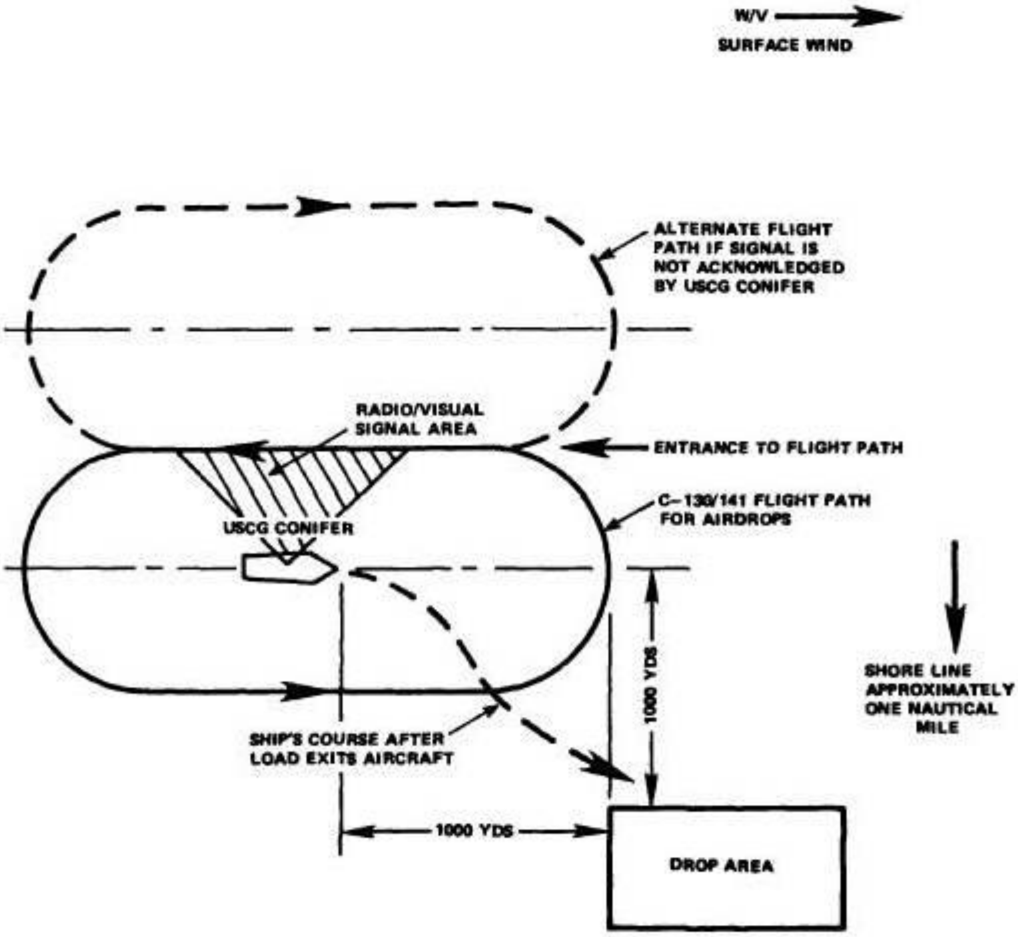

Figure 15 — Flight and Recovery Patterns for Wallops Island Range Airdrops

feet (304 and 426 m) depending upon the size load to be dropped. This was 200 to 400 feet (60 to 120 m) higher than procedures call for, but was necessary so that radar tracking equipment could acquire and lock-on the load above surface clutter.

On 10 October 1974, four Heavy Airdrop Platform Loads were tested off Wallops Island, Virginia. All four loads were rigged as platform extracted/platform suspended loads, as specified in Army Manual TM 10-500-12/Air Force Manual TO 1367-1-8,[11] and retrieved using the Coast Guard Buoy Tender CONIFER (WLB-301). These loads were built by first placing pieces of 3 in. (7.5 cm) thick honeycomb on the floor of the Metric Airdrop Platform. The A-22 units were then spotted on the platform in a configuration to balance about both lateral and longitudinal center lines. Six and ten A-22 units were used on the 12 and 20-foot (3.65 and 6.0 m) Metric Platforms, respectively. Tiedown webs, fastened to the platform by load binders, were lashed across the top of the A-22 units and over the corners and short sides of the platform. These webs secured the A-22 units to the platform and prevented the load from breaking apart during the airdrop and retrieval phases of the operations.

After the A-22 units were secured to the airdrop platform, the sea painters, messenger line, and a lifting grommet were rigged to the loads. Two sea painters, 1 in. (2.54 cm) diameter and 150 ft (45.7 m) long, were attached to diagonal corners of the platform and accordian folded on the front end of the load. The free ends of the sea painters were joined to form a loop. The lifting grommet was attached to the load at the load coupler and was used to lift the load aboard ship. A messenger line was run through the lifting grommet and the ends were joined to form a loop; it was then tied off along one of the sea painters. This enabled a seaman to capture both sea painters and the messenger line by hooking at any point along the sea-painter loop with a grapnel. Once the sea painter/messenger was brought on board, a seaman separated them and the sea painters were used as tag lines to control the load. One end of

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[11] "Airdrop of Supplies and Equipment Rigging Typical Supply Loads," Departments of the Army and the Air Force, Army TM 10-500-12/Air Force TO 13C7-1-8 (May 1973).

the messenger was attached to the crane hook trip line, and the other end was held by a seaman who used the messenger to snap the lifting grommet over the hook. The messenger then became a tag line to control the hook. Three G-11A parachutes with 80 foot (24.3 m) riser extensions were used on the 8000-lb (3628 kg) loads and five G-11A parachutes were used on the 18,000 lb (8164 kg) load. A 4-sec delay reefing cutter was attached to the sea painter and messenger line; it fired after the parachutes had deployed to release the sea-painters and messenger line. Figure 16 is a schematic of the rigging details, and Figure 17 shows a heavy airdrop load in the parachute deployed configuration. These heavy airdrop loads were inspected and certified by an Air Force loadmaster for airdrop. After the loads were placed aboard the aircraft, a flight safety officer performed an inspection prior to takeoff.

The three "six pack" loads and the "ten-pack" load of A-22 containers were rigged on 463L Metric Airdrop Platforms. The airdrop sequence was two "Six-packs" of gross weights 7410 lb and 8890 lb (3361 and 4032 kg) respectively delivered from an Air Force C-130 aircraft on the first sortie followed by a 8690-lb (3941 kg) and the 18,040-lb (8182 kg) load dropped from a C-141 aircraft an hour-and-a-half later on the second sortie. The first load was recovered from the water within 11 minutes after it had exited the aircraft. The second airdrop load of the sequence was retrieved in 28 minutes. Drops from the C-141 were made consecutively with no attempt at retrieval of the first load until both loads had been dropped. All four loads were recovered without any major problems. All of these test loads were watertight and sustained no damage, but the rails for the 12K Force Transfer Device on the 20-foot (6.0 m) long metric platform were bent beyond repair during load retrieval. This device, attached to the platform rails, is used as the extraction parachute attachment point for platform extracted loads built on Metric Airdrop Platforms. A minor problem was that the 24-in. (.61 m) diameter lifting grommet must be secured to the load coupler to provide a stable lifting point. The tested configuration resulted in the load tilting slightly from horizontal when it was lifted. This complicated handling the load over the ship deck edge.

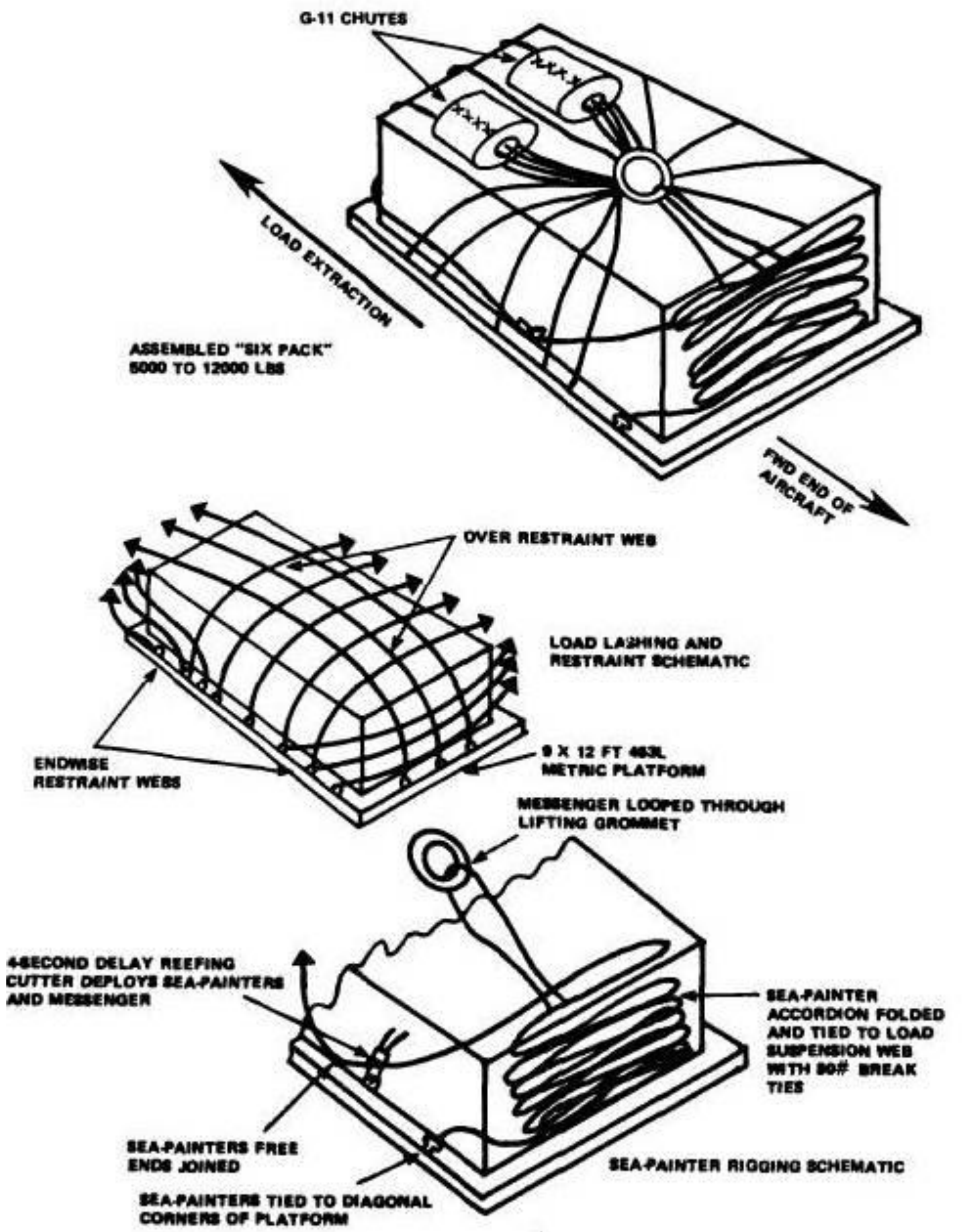


Figure 16 — "Six-Pack" Platform Suspended Load Details

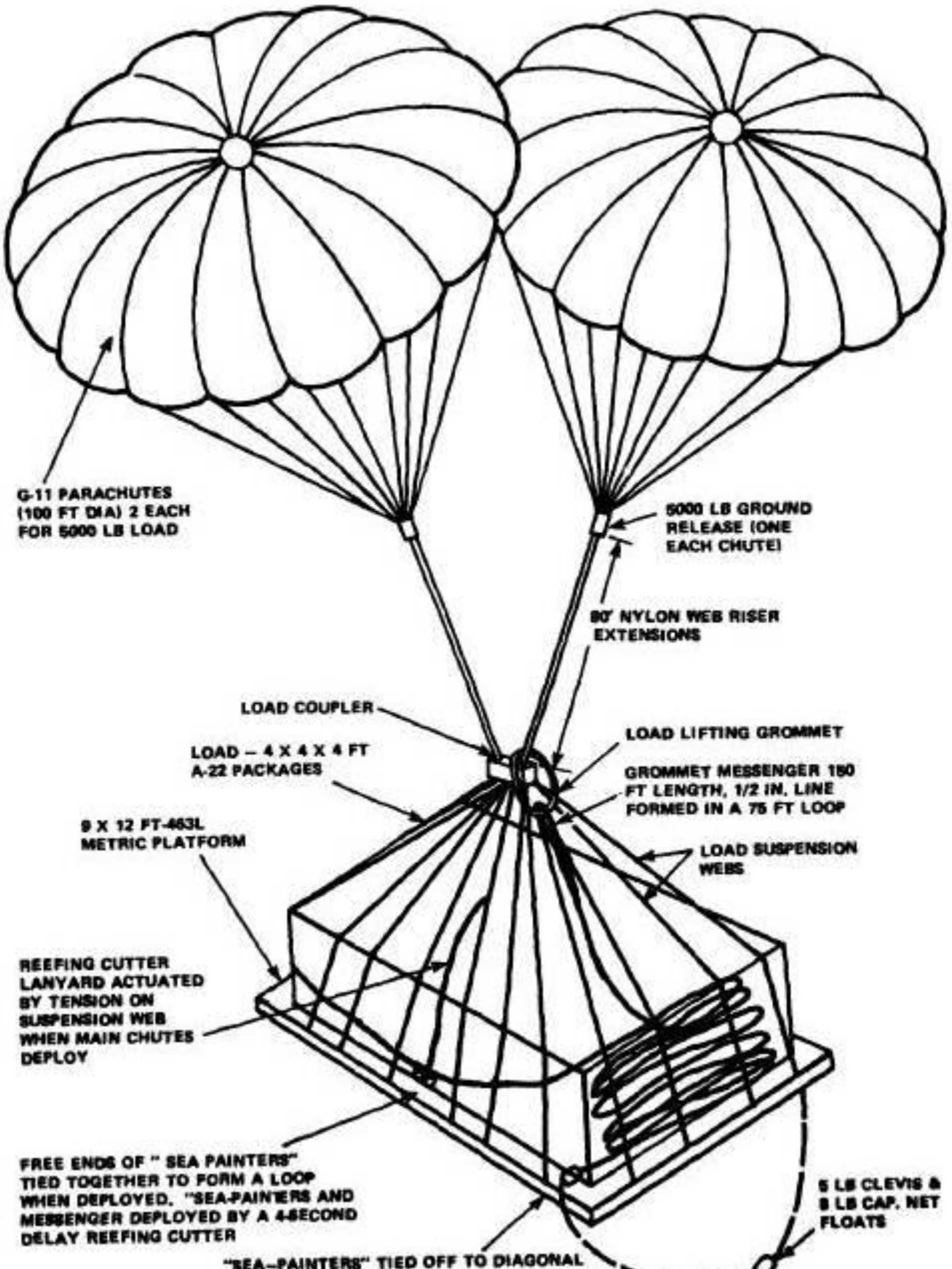


Figure 17 — Heavy Airdrop "Six-Pack" Load in Chute Deployed Descent Configuration

4.3.2 Salton Sea

The second series of range airdrops occurred during November 1975 and involved the airdrop testing of the missile/ordnance items previously static drop tested at the Naval Weapons Handling Center (NWHC), Colts Neck, N.J. This series of airdrops was a coordinated effort, with DTNSRDC having overall responsibility. U.S. Army Yuma Proving Ground, (YPG) Arizona was assigned responsibility for detailed test direction; provision of riggers, facilities and rigging materials; and instrumentation. They were assisted by U.S. Marine riggers from Camp Lejeune, N.C., and U.S. Marine Reconnaissance Troops from Recon Section; Landing Force Training Command, Pacific, who supplied and manned small chase boats. The National Parachute Test Range (NPTR) supplied and manned chase aircraft, large chase and target boats. The U.S. Air Force MAC provided the airdrop aircraft. Detailed engineering and load design was the responsibility of NARADCOM and NWHC. MAC utilized these airdrops to train several aircrews in NEACDS procedures. The loads were built and rigged at the U.S. Army Yuma Proving Ground, Arizona, and were airdropped at the National Parachute Test Range (NPTR) Salton Sea Facility, CA. Two each of the five missile/ ordnance loads, total of 10, were airdropped. The airdrops were scheduled every other day, except weekends, over a two-week period from 14 through 25 November. The two drops of each load type were planned two to three days apart so that changes could be made, if necessary, to the second of each load type based on the experience gained from the first. The airdrop aircraft was a C-141 flown out of Norton AFB, CA. to the YPG Laguna Airstrip where the loads were put aboard. The aircraft then flew to the Salton Sea Range, made the airdrops, (two per sortie) and returned to Norton AFB. In preparation for these airdrops, the payloads were assembled, instrumented, built, and rigged at YPG between 25 October and 13 November 1975. Instrumentation sensor locations are shown in Figures 9 through 12, Section 4.2.2. Both ground-based still and motion pictures, and chase plane motion picture photography were provided by the NPTR, El Centro, CA.

All ten loads were successfully airdropped. Because calm winds (0-5 knots) and a smooth water surface prevailed during most of the test period, the MI releases, whose design threshold is 8 knots of wind, failed to function properly on eight of the ten airdrops. All sea painters deployed properly and were successfully used to retrieve the load.

The loads were opened at the test site and visually inspected for damage and water leakage. No physical damage was apparent and all loads were dry, except for the first MK-46 Torpedo load.

The instrumented payload container had approximately 1 in. of water in the bottom. Closer inspection indicated the water had probably entered through the instrumentation cable hole. It appeared that during retrieval of the load, it had been towed with the instrumentation cable hole forward. The second MK-46 Torpedo load was towed during retrieval by the other end, and no leakage was observed.

4.4 FLEET TRIALS

The final phase (for each category of load) in the feasibility testing program of NEACDS consisted of airdrops to Fleet units under operational conditions at sea. The first of these trials was conducted as part of the Command Unit Training Exercises (COMTUEX) 3-75 and 4-75, and as operational test drops with the USS NASHVILLE (LPD-13).

Loads dropped to the DD and FF type ships during COMTUEX 3-75 and 4-75 were dummy A-22 payloads of concrete and A-7A loads of cases of soft drinks. These payloads were readily available, inexpensive, and could be prepared for airdrops in the limited time available preceding the test drops.

For the NASHVILLE, representative candidate items for NEACDS airdrops were provided by the Naval Sea System Command (NAVSEA), the Naval Electronics Command (NAVELEX), and the Naval Air System Command (NAVAIR) at the request of the Naval Material Command (NAVMAT). Naval Supply Command (NAVSUP) was assigned the lead responsibility in assembling these representative payloads for this airdrop test at the MAC Air Terminal, Naval Air Station Norfolk, VA. Enough material was assembled to stuff 12 triple wall containers 39 1/4 in. long by 47 in. wide by 38 1/4 in. (.99 by 1.19 by .97 m) high as A-22 loads. NAVSEA material included a radar scanner, antenna coupler, and various repair parts. NAVELEX materials included oscilloscopes, spectrum analyzers, power supplies, and other electronics components. NAVAIR submitted such items as radio sets, recorders, and receivers. A complete list of the items airdropped to the USS NASHVILLE is provided in Tables 8 and 9.

Three major changes were made to the packaging and rigging of the A-7A and A-22 loads from the procedures used in the Wallops Island tests. First after the payload items were stuffed into the container, honeycomb and cellulose wadding were used as cushioning instead of the foam-in-place resin. The honeycomb and wadding provided a less cumbersome method because it required no special equipment, it maintained the tightness of the payload and the packing procedure was faster. The second change involved using a waterproof cloth-backed pressure tape to seal the poly bags. This tape offered as good a waterproof seal as that achieved using the portable heat seal but again was faster, required no special equipment, and was generally available at both airdrop rigging facilities and Naval Supply Centers. The third change involved rigging the sea-painter separately from the riser extension. Standard 60-foot (18 m) parachute riser extensions were used on the A-7A loads, and standard 80-foot (24m) were used on the A-22 loads.

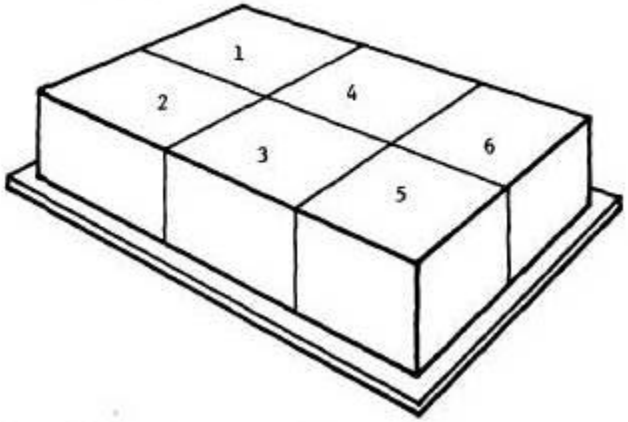
The floating sea-painters were accordian folded on the front of the load. One end was attached to the load suspension clevis. The other end was secured by a 4-sec pyrotechnic delay cutter. The cutter was activated by a lanyard attached to the suspension webs. As the main parachute deployed, tension on the webs pulled the lanyard to activate the cutter. Four seconds after the parachute deployed, the pyrotechnic delay cutter fired, deploying the sea painter. This rigging procedure enabled a lighter, less expensive line to be used as a sea-painter since this line did not have to withstand the parachute opening force.

The USS CONNOLE (FF-1056), USS MCDONNELL (FF-1043), and USS PAUL (FF-1080) tests were part of COMTUEX 3-75 during October 1974. The USS NASHVILLE (LPD-13) drops were made as a separate exercise on 24 November 1974; the drops to the USS NEW (DD-818) on 25 November 1974 were part of COMTUEX 4-75.

On 22 October 1974, between 0930 and 1130 hours, an Air Force C-130 dropped three loads, an A-7A of 300-lb (136 kg) gross weight and two

TABLE 8 - LOAD NO. 1 PAYLOAD CONFIGURATION

HEAVY AIRDROP LOAD NO. 1
PAYLOAD WGT. = 3270 lb
TOTAL GROSS WGT. = 4900 lb



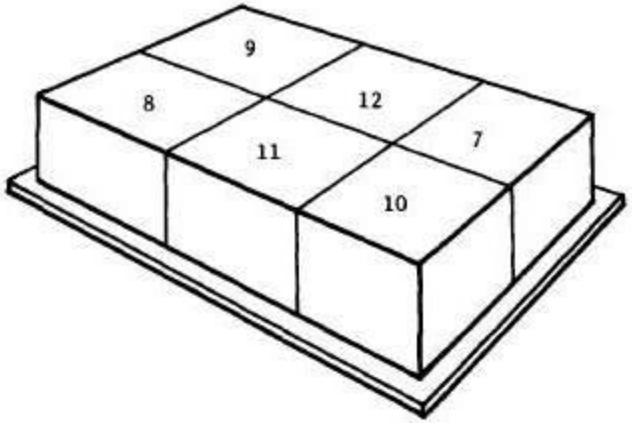
A-22 UNIT NO.	ITEM DESCRIPTION	FEDERAL STOCK NUMBER	QUANTITY	UNIT WEIGHT (lb)	UNIT CUBE (cuft)	TOTAL WEIGHT (lb)	TOTAL CUBE (cuft)
1	Power Supply	6130-00-999-1599	3	49.0	1.20	147.0	3.60
	Azimuth Control	5826-00-593-3747	4	4.0	.23	16.0	0.92
	Power Supply	5864-00-307-3781	4	66.0	4.00	264.0	16.00
	Antenna Coupler	5895-00-084-8496	1	-	-	-	-
						427.0	20.52
2	Recorders	5898-00-610-2394	4	40.3	3.00	161.2	12.00
	Antenna Drive	5895-00-688-6923	1	30.0	1.60	30.0	1.60
	Microwave Spectrum Analyzer	6625-00-139-9053	1	75.0	5.10	75.0	5.10
	Radio	5820-00-756-9906	3	-	1.00	-	-
						266.2	19.70

TABLE 8 - (Continued)

A-22 UNIT NO.	ITEM DESCRIPTION	FEDERAL STOCK NUMBER	QUANTITY	UNIT WEIGHT (lb)	UNIT CUBE (cuft)	TOTAL WEIGHT (lb)	TOTAL CUBE (cuft)
3	Oscilloscope	6625-00-169-1649	1	50.0	3.90	50.0	3.90
	Radio	5820-00-933-2407	1	6.6	.29	6.6	.29
	Radio Receiving Set	5820-00-948-3384	1	85.0	3.00	85.0	3.00
	Azimuth Control	5826-00-593-3747	2	4.0	.23	8.0	.46
	Power Supply	5865-00-307-3781	1	66.0	4.00	66.0	4.00
	Radios	5820-00-756-9906	9	-	1.00	-	1.00
						215.6	12.65
4	Oscilloscope	6625-00-169-1649	1	50.0	3.90	50.0	3.90
	Radio Receiving Set	5820-00-948-3384	1	85.0	3.00	85.0	3.00
	Case Control	5840-00-415-6637	1	37.0	4.00	37.0	4.00
	Electronic Gate	5840-00-005-7988	1	31.0	4.50	81.0	4.50
	Radios	5820-00-756-9906	2	-	1.00	-	2.00
						253.0	17.40
5	Radios	5820-00-933-2407	3	6.6	.29	19.0	.23
	Azimuth Control	5826-00-593-3747	1	4.0	.23	4.0	16.00
	Power Supply	5865-00-307-3781	4	66.0	4.00	264.0	5.00
	Radar Scanner	1285-00-399-8250	1	150.0	5.00	150.0	1.00
	Radios	5820-00-756-9906	4	-	1.00	-	
						437.8	23.10
6	Repair Parts	4329-LL-HAE-0666	1	45.0	1.50	45.0	1.50
	Radio Receiving Set	5820-00-948-3408	1	152.0	7.50	152.0	7.50
	Radio Sets	5820-00-930-3724	2	25.0	1.20	50.0	2.40
	Azimuth Controls	5826-00-593-3747	2	4.0	.23	8.0	.46
	Receivers	5821-00-109-6048	6	7.0	1.30	42.0	7.80
	Radios	5820-00-756-9906	3	-	1.00	-	3.00
						297.0	22.66

TABLE 9 - LOAD NO. 2 PAYLOAD CONFIGURATION

HEAVY AIRDROP LOAD NO. 2
PAYLOAD WGT. = 3070 lb
TOTAL GROSS WGT. = 4900 lb



A-22 UNIT NO.	ITEM DESCRIPTION	FEDERAL STOCK NUMBER	QUANTITY	UNIT WEIGHT (lb)	UNIT CUBE (cuft)	TOTAL WEIGHT (lb)	TOTAL CUBE (cuft)
7	Power Supply	6130-00-999-1599	1	49.0	1.20	49.0	1.20
	Radio Receiving Set	5820-00-948-3384	1	85.0	3.00	85.0	3.00
	Radio Sets	5820-00-930-3724	2	25.0	1.20	50.0	2.40
	Power Supply	5865-00-307-3781	2	66.0	4.00	132.0	8.00
	Switch Box	1290-00-933-9789	1	30.0	1.00	30.0	1.00
	Radios	5820-00-756-9906	2	-	1.00	-	2.00
						346.0	17.60
8	Oscilloscope	6625-00-169-1649	1	50.0	3.90	50.0	3.90
	Recorders	5895-00-610-2394	2	40.2	3.00	80.6	6.00
	Radio Receiving Set	5820-00-948-3408	1	152.0	7.50	152.0	7.50
	Power Supply	5865-00-307-3781	1	66.0	4.00	66.0	4.00
						348.0	21.40

TABLE 9 - (Continued)

A-22 UNIT NO.	ITEM DESCRIPTION	FEDERAL STOCK NUMBER	QUANTITY	UNIT WEIGHT (lb)	UNIT CUBE (cuft)	TOTAL WEIGHT (lb)	TOTAL CUBE (cuft)
9	Recorders	5895-00-610-2394	2	40.3	3.00	80.6	6.00
	Power Supply	5865-00-307-3781	2	66.0	4.00	132.0	8.00
	Gyroscope	6615-00-684-5637	1	10.0	1.20	10.0	1.20
	Microwave Spectrum Analyzer	6625-00-139-9053	1	75.0	5.10	75.0	5.10
	Radios	5820-00-756-9906	4	-	1.00	-	4.00
						297.6	24.30
10	Azimuth Control	5826-00-593-3747	2	4.0	.23	8.0	.46
	Power Supply	5865-00-307-3781	4	66.0	4.00	264.0	16.00
	Oscilloscope	6625-00-169-1649	1	50.0	3.90	50.0	3.90
	Antenna Drive	5895-00-688-6923	2	30.0	1.60	60.0	3.20
	Radio	5820-00-756-9906	1	-	1.00	-	1.00
						382.0	24.56
11	Power Supply	5865-00-307-3781	4	66.0	4.00	264.0	16.00
	Receiver	5821-00-109-5048	1	7.0	1.30	7.0	1.30
	Antenna Drive	5895-00-688-6923	3	20.0	1.60	90.0	4.80
	Radio	5820-00-756-9906	5	-	1.00	-	5.00
						361.0	27.10
12	Receiver	5821-00-990-1411	1	40.0	3.00	40.0	3.00
	Power Supply	5865-00-307-3781	2	66.0	4.00	132.0	8.00
	Receiver	5821-00-109-6048	1	7.0	1.30	7.0	1.30
	Antenna Drive	5895-00-698-6923	1	30.0	1.60	30.0	1.60
	Radio	5820-00-756-9906	6	-	1.00	-	6.00
						209.0	19.90

A-22 loads of 600-lb (272 kg) and 1600-lb (725 kg) gross weights, to the USS CONNOLE. Sea conditions at the drop zone approximated sea state 3 to 4 with surface winds of 15 to 20 knots. The aircraft flew at 130 knots and dropped from a 1000-foot (304 m) altitude. All three loads were retrieved without any major difficulties. Some trouble was encountered maneuvering the ship alongside the third load because the ship's stern was facing into the direction of the sea, making maneuvering and ship handling more difficult than if the ship's bow had been pointed into the sea. The ship's ASROC handling boom, having a dynamic working load of 2100 lb (952 kg) and mounted starboard just forward of the bridge on the main deck, was used to retrieve the loads. The data recorded for each airdrop, recovery, and retrieval operation are given in Table 10.

The second airdrop made as part of COMTUEX 3-75 occurred on 24 October 1974 between 0930 and 1030 hours to the USS MCDONNELL. An Air Force C-130 dropped two A-7A loads, each with a rigged weight of 430 lb (195 kg). Sea state during these drops was estimated at 1-2 with winds of 8-12 knots. The aircraft drop speed was 130 knots at a 1000-foot (304 m) altitude. The ship's portable davit, dynamic working load 600 lb (272 kg), mounted just aft of mid-ships on the main deck, was used to retrieve the loads. The parachute on the first load failed to open due to either a faulty parachute release mechanism or a broken sea painter (which was also being used as a parachute riser extension). The second load was dropped and retrieved successfully. Table 10 provides the data for this airdrop.

The final airdrops made as part of COMTUEX 3-75 were made to the USS PAUL. On 26 October 1974 between 1000 and 1200 hours an Air Force C-130 dropped four A-22 loads, two each of 600 lb (272 kg) and 1600 lb (725 kg) respectively. Sea state during this operation was 1 with surface winds of 4-8 knots. The C-130's drop speed was 130 knots at an altitude of 1000 ft (394 m). The PAUL, before approaching the first two loads, made a Williamson turn on the approach to the first load and an S turn on the approach to the second load. These ship maneuvers resulted in longer load retrieval times than prior retrievals and were not necessary in bringing the ship alongside the load. The ship's ASROC handling boom, erected on the starboard side of the forecastle, was used to retrieve the loads. The major difficulty encountered during this airdrop was the failure of the parachute to release at water surface impact on the second 600-lb (227 kg) load. The ship's bow with its submerged sonar dome ran over the attached parachute before a seaman could cut the sea painter. However, when the sea painter was cut, the parachute sank immediately and the load was lifted aboard. Table 10 provides the quantitative data on these airdrops.

The second at sea trial was on 24 November 1974 between 1100 and 1300 hours. A Tactical Air Command (TAC) C-130, flying out of Pope Air Force Base, N.C., dropped two heavy airdrop loads to the USS NASHVILLE (LPD-13) off the coast of Charleston, South Carolina. Sea state at the drop zone (DZ) was approximately one. The aircraft flew at 130 knots and dropped the loads from a 1000-foot (304 m) altitude. The payloads consisted of "real world" CASREPT items. The first load airdropped had a rigged weight of 4700 lb (2131 kg). This load was retrieved utilizing the ship's 10-ton (9.07 metric ton) capacity crane equipped with a trip hook. At load splashdown, the two G-11 parachutes released from the load; however, because of the low wind velocity, (1-5 knots), the parachutes did not blow very far from the load even though they had separated successfully. When the ship approached the load for retrieval, one of the parachutes became tangled in her starboard propeller. The chute had to be removed the next day by a diver. This load was retrieved and secured aboard the flight deck in a total time of 21 min: 30 sec after it had exited the aircraft.

The second load had a rigged weight of 4900 lb (2222 kg). A different retrieval method was tried which involved capturing the sea-painters, floating the load aft, and then winching it into the ship's flooded-down welldeck. During this operation the A-22 units began to come loose from the airdrop platform because the honeycomb between the A-22 units and the platform floor became waterlogged and disintegrated. When the load was finally secured in the welldeck, 55 min after it had exited the aircraft, all six A-22 loads were floating as separate units apart from the platform, held together only by the lashings. Table 10 provides a summary of time and motion study data for the NASHVILLE drops.

TABLE 10 - NEACDS AIRDROP SUMMARY FOR FLEET TRIALS

DATE	SHIP	TYPE OF LOAD	SEA STATE	RIGGED WGT. (LB)	TIME TO SPLASHDOWN (MIN:SEC)	SPLASHDOWN/ SHIP ALONGSIDE (MIN:SEC)	SHIP ALONGSIDE/ ON BOARD (MIN:SEC)	TOTAL TIME (HRS: MIN: SEC)	REMARKS
10/24/74	USS CONNOLE (FF-1056)	CONCRETE	3-3 1/2	450	00:45	05:05	13:30	0:19:20	
		CONCRETE	3-3 1/2	990	00:38	07:50	05:00	0:13:28	
		CONCRETE	4	1900	00:20	32:00	03:15	0:36:05	
10/24/74	USS EDWARD MCDONNELL (FF-1043)	CONCRETE	1-2	430	-	-	-	-	Parachute did not deploy
		CONCRETE	1-2	430	00:45	05:50	03:10	0:09:45	
10/26/74	USS PAUL (FF-1080)	CONCRETE	1	950	00:45	22:40	08:10	0:31:30	
		CONCRETE	1	950	00:35	15:45	10:35	0:26:55	
		CONCRETE	1	1755	00:25	09:05	04:40	0:14:10	
		CONCRETE	1	1755	00:30	07:15	06:05	0:13:50	
11/24/74	USS NASHVILLE (LPD-13)	ELECTRONICS PARTS	1	4700	01:30	07:00	13:00	0:21:30	Crane retrieval
		ELECTRONICS PARTS	1	4900	01:30	15:30	38:00	0:55:00	Well deck retrieval

TABLE 10 - (Continued)

DATE	SHIP	TYPE OF LOAD	SEA STATE	RIGGED WGT. (LB)	TIME TO SPLASHDOWN (MIN:SEC)	SPLASHDOWN/ SHIP ALONGSIDE (MIN:SEC)	SHIP ALONGSIDE/ ON BOARD (MIN:SEC)	TOTAL TIME (HRS:MIN: SEC)	REMARKS
11/25/74	USS NEW (DD-918)	CASES OF COCA-COLA	2-3	203	00:50	05:35	01:10	0:07:35	
		CASES OF COCA-COLA	2-3	198	00:45	05:45	01:15	0:07:45	
		CONCRETE	2-3	1050	00:30	10:45	02:20	0:13:35	
		CONCRETE	2-3	1190	00:35	05:10	09:30	0:15:15	
3/22/76	USS FARRAGUT (DDG-37)	MK 46 TORPEDOES SPLIT FOUR PACK	3	4271	00:57	48:21	2:27:22	3:16:40	Retrieval lines broken
3/23/74	USS CONCORD (AFS-5)	SIX INERT SHRIKE MISSILES (AGM-45)	3	5645	00:46	62:00	44:00	1:46:46	W/V N.E. 12-20 KTS Load overturned in water
3/23/76	USS CONCORD	FOUR, PACK AN/SSQ-41A SONOBUOYS	3	5264	01:02	18:00	20:10		First pallet on board
							2:30		Second pallet on board
							3:22		Third pallet on board
							3:02	0:48:04	Fourth pallet on board

TABLE 10 - (Continued)

DATE	SHIP	TYPE OF LOAD	SEA STATE	RIGGED WGT. (LB)	TIME TO SPLASHDOWN (MIN:SEC)	SPLASHDOWN/ SHIP ALONGSIDE (MIN:SEC)	SHIP ALONGSIDE/ ON BOARD (MIN:SEC)	TOTAL TIME (HRS:MIN: SEC)	REMARKS
3/24/76	USS CONCORD (AFS-5)	TWO INERT STANDARD ARM (AGM-78) MISSILES	1	5400	00:48	10:12	20:45	0:31:45	W/V/ E.N.E. Less than 10 KTS
3/24/76	USS CONCORD (AFS-5)	FOUR MK 46 TORPEDOES	1	4271	00:46	43:59	10:00	0:54:45	Sea painter did not deploy
3/24/76	USS CONCORD (AFS-5)	FOUR AN/SSQ-41A SONOBUOYS	1	5264	00:47	11:28	25:05	0:37:20	
5/18/76	USS MILWAUKEE (AOR-2)	FOUR AN/SSQ-41A SONOBUOYS	3	5264	00:45	16:25	29:20	0:46:30	Tag line broke free from sea-painter and wrapped around the load
5/19/76	USS MILWAUKEE (AOR-2)	TWO INERT STANDARD ARM (AGM-78) MISSILES	2-3	5400	00:45	15:00	50:15	1:06:00	

When the two heavy airdrop loads were returned to shore and off-loaded, the A-22 units were examined first to see if they remained water-tight. Two units which had floated upside-down in the welldeck contained approximately a pint of water in each unit. Both of these units were waterproofed with a new type "Zip Lock" bag which had not previously been tested. All the payload items that were airdropped were then sorted and returned to the cognizant activity for damage assessment and testing. All but two of the 131 units survived the airdrops and were certified Ready For Issue (RFI). The two defective items, an oscilloscope and a microwave spectrum analyzer, survived the airdrop but needed recalibration. Although these two items were certified RFI before the airdrop, time did not permit a precalibration to insure that these items were, in fact, properly calibrated. Table 11 summarizes the items tested and their damage assessment.

During COMTUEX 4-75, the NEACDS was tested on 25 November 1974 between 1015 and 1110 hours. An Air Force C-130, flying out of Pope AFB, dropped four payloads, two each A-7A's of 200-lb (90 kg) nominal gross weight, one A-aa of 1050-lb (476 kg), and one of 1190-lb (539 kg), to the USS NEW (DD-818). Each of the 200-lb (90 kg) payloads was composed of six cases of soft drinks plus ballast. The 1050-lb and 1190-lb (476 and 539 kg) payloads were concrete. Sea state at the drop zone was estimated at 2-3 with surface winds of 10-15 knots. Aircraft drop speed and altitude were 130 knots and 1000 feet (304 m), respectively. The two 200-lb (90 kg) loads were retrieved on the starboard forecastle using the ship's portable davit with a 750-lb (340 kg) dynamic working load. The two heavier A-22 loads were retrieved by using the forward boat davit on the starboard side, which had a 2400 lb (1090 kg) working load, and by fair-leading the sea painters to a powered winch aft on the main deck. The winch, however, was not in working order so each of the heavy loads was manhandled aboard. All the sea painters deployed properly except the one on the 1190 lb (539 kg) A-22 load. On this load, approximately 70 ft (21.3 m) of sea painter remained attached to the load. However, the 30 ft (9.1 m) length which did deploy provided enough line for the seaman to capture on the fourth cast with the grapnel hook. Time and motion study data are provided as part of Table 10.

TABLE 11 - PAYLOAD ITEM TEST SUMMARY

ITEM DESCRIPTION	FEDERAL STOCK NUMBER	QUANTITY	REMARKS
	NAVSEA MATERIAL		
H.F. Radio Receiving Set	5820-00-948-3408	2	Survived -- RFI
Power Supply	6130-00-999-1599	4	" "
VHF Transceiver	5820-00-930-3724	6	" "
VHF Radio	5820-00-948-3384	3	" "
Oscilloscope	6625-00-169-1649	4	Survived but required recalibration
Microwave Spectrum Analyzer	6625-00-139-9053	2	" "
Transponder Case	5840-00-415-6637	5	Survived -- RFI
Electronic Gate	5840-00-005-7968	5	" "
	NAVAIR MATERIAL		
Radar Scanner	1285-00-399-8250	1	Survived -- RFI
Switch Box	1290-00-933-8789	1	" "
Repair Parts Box	4329-LL-HAE-0666	1	" "
Antenna Coupler	5985-00-084-8496	1	" "
Gyroscope	6615-00-684-5637	1	" "
Receiver	5821-00-109-6048	5	" "
Receiver	5821-00-990-1411	1	" "
Recorder	5895-00-610-2394	8	" "
Antenna Drive	5820-00-688-6923	7	" "
Radio	5820-00-933-2407	6	" "
Radio Receiver	5820-00-756-9907	37	" "
Azimuth Control	5826-00-593-3747	9	" "
Power Supply	5827-00-307-3781	24	Test results not submitted

The second sub-series of sea trials involved three U.S. Navy ships during the Spring of 1976. The purpose of these tests was to test the feasibility of airdropping and retrieving missile/ordnance items in an at sea environment. The first ship participating in these tests was the USS FARRAGUT (DDG-37) on 22 March 1976 off the Virginia Capes. One airdrop load of four MK 46 Torpedoes weighing 4271-lb (1937 kg) was delivered to the USS FARRAGUT by an Air Force C-130 aircraft. This load was designed to split apart into four individual units each weighing 990-lb (449 kg) so that each torpedo and its container was within the lift capability of the ship's portable davit. Sea conditions at the drop zone were approximating sea state 3 with winds from the N-Ne at 10-20 knots. After load extraction from the aircraft the 300-ft (91.4 m) sea painter fouled and did not deploy properly. Two attempts were made before the sea painter was captured and the load split apart in the water. This line broke after it was passed through a bit and then fairlead to a powered capstan. The sea painter was finally recaptured and the load secured aboard with the aid of the ship`s boat. Inspection of the torpedoes revealed about 3 to 4 inches (7.5 to 10 cm) of water in one container and less than 1 inch (2.5 cm) of water in the other three. The exercise torpedo rounds were returned to Keyport, Washington, for a complete inspection. As presented under separate cover,[12] results of this inspection found no damage attributable to the airdrops.

On 23 March 1976, an Air Force C-130 dropped a platform load of SHRIKE missiles and an Air Force C-141 dropped a split-pack of sonobuoys to the USS CONCORD (AFS-5) off the Virginia Capes. The SHRIKE load had a total rigged weight of 5654-lb (2564 kg). The Air Force C-130 flew at 1000 feet (335 m) and 130 knots for the SHRIKE airdrop. Sea conditions at the drop zone were approximately sea state 3 with winds from the NE at 12-20 knots. The 9-foot by 12-foot (2.7 by 3.6 m) platform contained six inert SHRIKE missiles, three each in two CNU-167/E containers. Three

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[12] NUC Letter, 3515/AJT, 135085, 5 August 1976, Subj: "Torpedo MK 46, Naval Emergency Air Cargo Delivery System At-Sea Tests, Results of."

hundred feet (91 m) of 1-in. (2.5 cm) diameter sea painter deployed properly after main chute opening but the load inverted on water entry. A combination of several factors created this situation: load oscillation, delayed parachute detachment on impact, wind and wave action, and an inherent load instability in that the center of gravity was located above the center of buoyancy. Ship maneuvering presented a minor problem because the AFS is a large, single-screw ship. After the ship had made its approach alongside the load, the load was righted in the water by lifting the deployed 1-in. (2.5 cm) sea painter and backing the ship down.

The split sonobuoy load worked as designed with sea painter deployment and chute detachment occurring at the proper times. Ship maneuvering also improved on this second attempt. All four pallets were retrieved within 48 minutes. Ship's personnel recommended that the tag lines were not required; that a more rigid lifting ring be used to prevent the ring closing before the hook is inserted; and that a dye marker on the parachute and a smoke float on the deployed end of the sea painter would improve tracking in the water.

On 24 March 1976 an Air Force C-141 Aircraft dropped three ordnance loads including one each of Standard Arm Missiles, MK 46 Torpedos, and AN/SSQ-41A Sonobuoys. The Standard Arm load had a total rigged weight of 5400 lb, (2449 kg). Conditions at the drop zone were approximately Sea State 1 with winds from the East-Northeast at less than 10 knots. The sea-painter deployed properly and the load was retrieved in approximately one-half hour. The MK-46 Torpedo load had a total rigged weight of 4271 lb (1936 kg). The sea-painter failed to deploy on this load and the pyrotechnic cutters remained armed. Ship's personnel marked the parachute with dye markers. Two approaches were made, but attempts to grapple the sea-painter were unsuccessful. The hook line attachment was finally made with a man over the side. The third load of sonobuoys weighing 5264 lb (2387 kg) was retrieved in about 35 minutes without any problems.

On 13 May 1976 an Air Force C-141 aircraft dropped a 4-pack sonobuoy load to the USS MILWAUKEE (AOR-2) off Camp LeJeune N.C. during Exercise Solid Shield 76. The 8-foot by 9-foot (2.4 by 2.7 m) platform load (four pallets) of AN/SSQ-41A sonobuoys had a total rigged weight of

5264 lb (2387 kg). The C-141 aircraft flew at 150 knots with an 1100-ft (335 m) drop altitude. Conditions at the drop zone were approximating sea state 3 with winds from the SW at 13-20 knots. Three hundred feet (91 m) of polypropylene sea painter, activated by three guillotine type release knives cutting 1-in. (2.5 cm) tubular nylon, deployed properly. The two free ends of the messenger line loop, safety tied to the sea painter with 80-lb (36 kg) cord, broke loose when the sea painter deployed. The ship approached the load simulating an anchorage problem, i.e. the ship pointed her bow directly at the load. Salt water activated dye markers on both the extraction parachute and main parachute identified them once they were in the water. When the load was alongside, the sea painter and both ends of the messenger line were grappled individually. The load was secured aboard in 46 min 30 sec.

A Standard Arm Missile load was dropped on 14 May. The aircraft had maintenance problems at Charleston AFB, S.C. and did not arrive on station until 1730 hours. The sea painter and messenger deployed properly. Ship's crew attached an 1800-lb (816 kg) break strength line to the trip chain hook and tied it through the loop in the messenger line. The wave action and hook tension broke the fairlead line before the hook was through the lifting ring. Several attempts were made to snag the lift ring with a grapnel hook. Finally a suspension web was grappled and the load was lifted aboard by a suspension web. The split sonobuoy load was not airdropped due to impending darkness. Table 10 is a summary of the missile and ordnance airdrop tests.

4.5 OPERATIONAL PROCEDURES

The Air Force mission profile is divided into three areas: enroute, target area, and airdrop. Although the mission profile may vary with the type of aircraft, the following general procedure is used: (A more detailed description is given by Kelly and O'Day [3].)

The aircraft proceeds to the target area on Instrument Flight Rules (IFR) at cruise altitude as required. Flight planning, clearance, and enroute procedures are in accordance with appropriate AF directives. Fuel allocation is planned for a minimum of one hour low level loiter time over the Drop Zone (DZ). Figures 18 and 19 are the formats used by the aircraft and target ship. As soon as possible, the aircraft makes voice contact with the target ship on a predetermined frequency and exchanges airdrop data. Upon entering the target area the aircraft secures Air Traffic Control (ATC) clearance, descends to 4000-5000 feet (1.21-1.52 km) (depending on the type of aircraft), and navigates to the ship using airborne radar and any available shipboard navigation aids. When the target ship is identified on radar, the aircraft descends to drop altitude and maneuvers to pass on the starboard beam of the ship which will be on a downwind heading (drop axis). A racetrack pattern is flown around the ship until the final clearance for drop is given by the ship. Turning inbound for the airdrop leg, the aircraft establishes the required lateral offset to navigate to the Computed Air Release Point (CARP). The release point is measured from the ship's bow, and in no case is the release made prior to passing abeam of the ship's bow. If multiple drops are required, the aircraft racetrack flight procedures continue until the ship gives the clearance for the next drop. Figures 20-22 summarize the Air Force mission profile. The Air Force minimum weather requirements are presently a 2500-feet (.761 km) ceiling and 5-mile (8.0 km) visibility at the DZ.

While the aircraft is flying the racetrack flight pattern, the target ship heads downwind at a speed of 10-15 knots. When the load is released from the aircraft, the ship takes a course to close on the impact area. Normal procedure dictates that the ship approach the load bow on to determine whether the parachutes are clear of the load. The ship then makes an approach to put the load on the side of her retrieval gear. A seaman standing near the bow heaves a grapnel over the deployed floating sea-painter. The sea-painter is hauled aboard and walked to the retrieval gear. The load is then hoisted aboard by the ship's lifting gear.

PREBRIEFED ITEMS

1. Airdrop data:_________pounds on __________platform, _______passes.
Drop altitude______feet absolute;
Estimated drop axis_________degrees true;
Point of impact:_______yards starboard,______yards past ship's bow.
Estimated barometric pressure________inches.

2. Rendezvous Time______; Minimum loiter time___________.

3. Rendezvous ________N/S____________E/W;
Ship speed_________K, direction______________at rendezvous.

4. Ship's Description: Call sign________;
Type Ship __________(superstructure description);
Call Number___________;

5. Aircraft description:
Type aircraft_____ __;

6. Radio frequencies: UHF_______(primary)______(secondary);
VHF________(primary)__________(secondary)
HF ________(primary)__________(secondary);

7. Navaid frequencies:
TACAN Channel___________;ADF Frequency__________.
Status of shipboard radar, UHF/DF, IFF, et al.

Aircraft and ships participating in NEACDS missions will use this format for exchange of rendezvous/airdrop data. Aircraft will contact target ship using Section I data, Figure 19. Ship will reply with Section II data.

Figure 18 - NEACDS Mission Briefing Data Worksheet

SECTION I - Aircraft Transmission

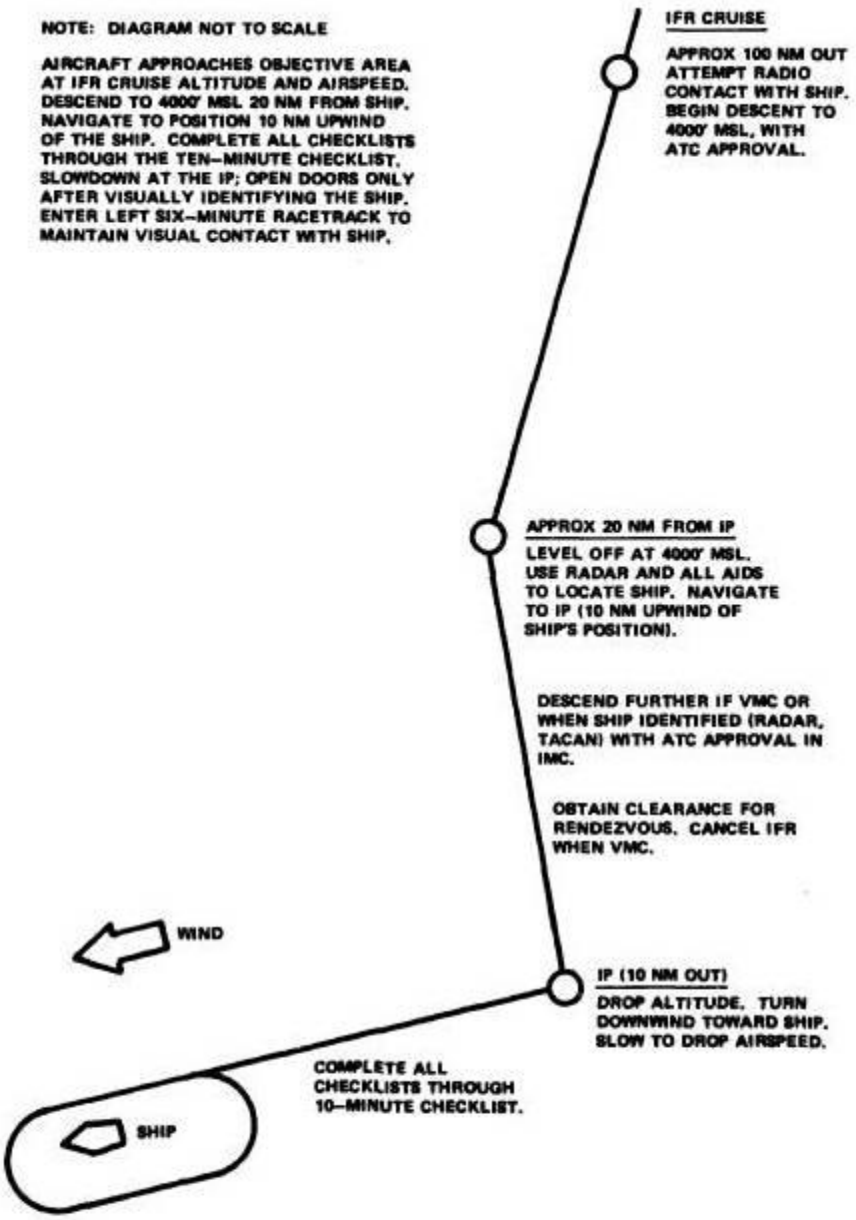
(Target Ship)________, this is (aircraft)________on frequency______
(After ship acknowledges, transmit the following message.)
(Target ship)_________, This is (aircraft)__________

1. Estimate rendezvous at _______Z.
2. Squawking IFF Mode_________Code_________
3. Currently________NM_______(true direction) from the rendezvous point at_______(Altitude, ft).
4. Revision of prebriefed data; special instructions. Request clearance for rendezvous.

SECTION II - Ship Transmission
(Aircraft)________This is (target ship)__________we copy all.

1. Revision of prebriefed data
2. Target area data: Barometric pressure________inches;
   Surface wind_______degrees true at__________knots;
   Drop axis_________degrees true.
   Temperature_________.
3. Other information will include encoded position, course, and speed. After positive contact and confirmation of position information,
4. Steer___________degrees true to our position.

Figure 19 - Aircraft and Ship Communications Worksheet



NOTE: DIAGRAM NOT TO SCALE

AIRCRAFT APPROACHES OBJECTIVE AREA AT IFR CRUISE ALTITUDE AND AIRSPEED. DESCEND TO 4000' MSL 20 NM FROM SHIP. NAVIGATE TO POSITION 10 NM UPWIND OF THE SHIP. COMPLETE ALL CHECKLISTS THROUGH THE TEN-MINUTE CHECKLIST. SLOWDOWN AT THE IP; OPEN DOORS ONLY AFTER VISUALLY IDENTIFYING THE SHIP. ENTER LEFT SIX-MINUTE RACETRACK TO MAINTAIN VISUAL CONTACT WITH SHIP.

IFR CRUISE

APPROX 100 NM OUT ATTEMPT RADIO CONTACT WITH SHIP. BEGIN DESCENT TO 4000' MSL, WITH ATC APPROVAL.

APPROX 20 NM FROM IP

LEVEL OFF AT 4000' MSL. USE RADAR AND ALL AIDS TO LOCATE SHIP. NAVIGATE TO IP (10 NM UPWIND OF SHIP'S POSITION).

DESCEND FURTHER IF VMC OR WHEN SHIP IDENTIFIED (RADAR, TACAN) WITH ATC APPROVAL IN IMC.

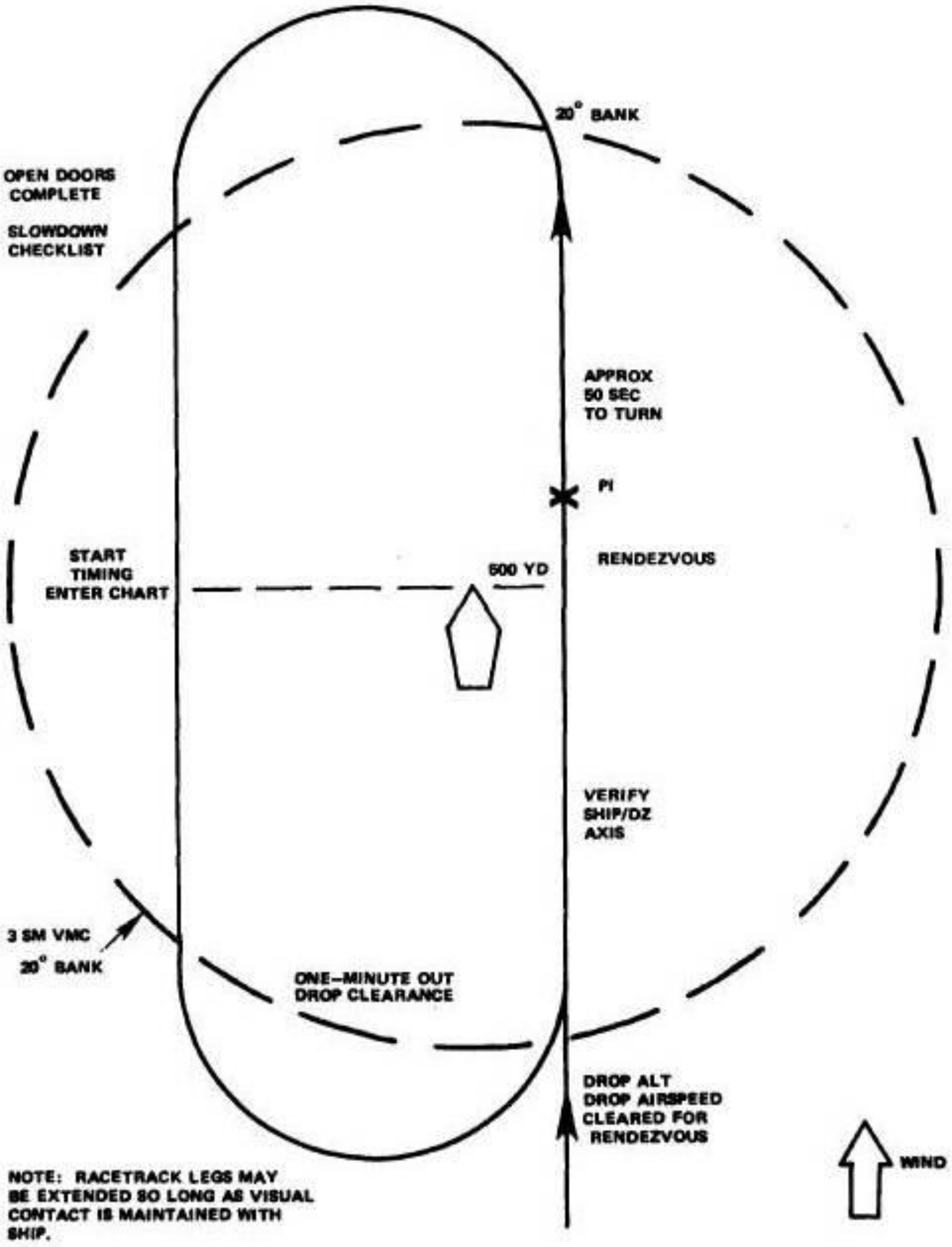
OBTAIN CLEARANCE FOR RENDEZVOUS. CANCEL IFR WHEN VMC.

IP (10 NM OUT)

DROP ALTITUDE. TURN DOWNWIND TOWARD SHIP. SLOW TO DROP AIRSPEED.

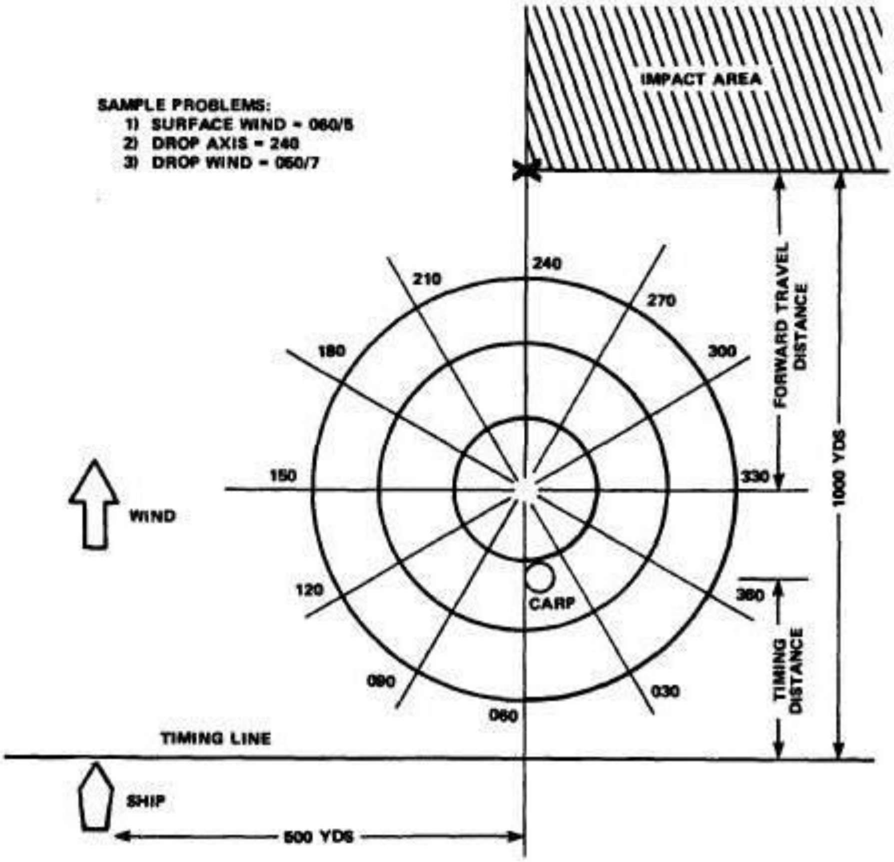
COMPLETE ALL CHECKLISTS THROUGH 10-MINUTE CHECKLIST.

Figure 20 - NEACDS Mission Enroute Profile



NOTE: RACETRACK LEGS MAY BE EXTENDED SO LONG AS VISUAL CONTACT IS MAINTAINED WITH SHIP.

Figure 21 - NEACDS Objective Area Flight Pattern



NOTE: DIAGRAM NOT TO SCALE.

PLAN RELEASE SO THAT THE LOAD WILL IMPACT NO CLOSER THAN 500 YARDS LATERALLY AND 1000 YARDS DOWNWIND FROM THE SHIP. THESE DISTANCES MAY BE INCREASED AT THE REQUEST OF THE SHIP. IN NO CASE WILL THE AIRCRAFT FLY CLOSER THAN 500 YARDS FROM THE SHIP DURING THE DROP SEQUENCE. DO NOT RELEASE LOAD PRIOR TO PASSING ABEAM THE SHIP. THE PI WILL BE ADJUSTED IF NECESSARY.

Figure 22 - NEACDS Airdrop Plan

SECTION 5
CONCLUSIONS

5.1 GENERAL CONCLUSIONS

The Naval Emergency Air Cargo Delivery System (NEACDS) program has tested and evaluated the feasibility of applying the airdrop concept of delivering cargo to ships at sea. Loads ranging in weight from 100 lb to 18,000 lb (45 to 8164 kg) were airdropped. These tests:

(1) established a method for waterproofing payloads using off-the-shelf materials,

(2) evaluated several types of shock mitigation material and determined those that would protect the payloads satisfactorily,

(3) developed a satisfactory flotation method,

(4) developed a reliable retrieval method for A-7A, A-22 and Heavy Airdrop platform loads; and

(5) successfully delivered real payloads which included ship parts, electronics equipment, and selected missile/ordnance items.

Time and motion study data were recorded for all drops to assess the problem areas encountered during the airdrop, recovery, and retrieval phases of the operation. Detailed conclusions for each phase of testing follow.

5.2 STATIC DROPS

5.2.1 Cheatham Annex

The primary purposes of these tests were to:

(1) Evaluate the use of the PIFC versus the MODCON;

(2) Develop waterproofing, shock mitigation, and flotation techniques; and

(3) Develop safe retrieval techniques without putting a man or boat in the water.

The PIFC was superior to the MODCON in terms of space utilization, cost, and overall damage to the containers. Waterproofing bag seals evolved from the hot glue gun and a single bag to the thermal seal machine and double bags on all loads. Testing showed that the 3-to-6 in. (7.5 to 15 cm) external honeycomb normally used under the load for land airdrop is not necessary for NEACDS airdrops because the load penetrates into the water, resulting in greater deceleration distance and reduced shock adequate shock mitigation for the payloads of canned provisions. Foam in place resin produced a tight payload, but was discarded because the hot foam tended to fuse the poly bags and destroy their watertight integrity. All loads were floated in the water, some in excess of 50 min, with no problem encountered.

5.2.2 Colts Neck

These static drops tested the design concepts for missile/ordnance items rigged as heavy airdrop platform loads for platform extraction and platform suspension. The objectives of the tests were to:

(1) Test load integrity and shock mitigation through splashdown;

(2) Test load flotation and waterproofing;

(3) Develop designs for splitting Four Pack platform loads for small ship retrieval; and

(4) Have Army Quartermaster School personnel take data for drafting riggers' Field Manuals

Through experience gained from the Cheatham Annex Static Drop Tests and use of typical Army rigging procedures for heavy airdrop platform loads, all the test objectives were achieved. Table 12 compares the individual payload item transportation design limits versus the static drop results for the final load configuration. On the basis of these results it was concluded that the NEACDS Missile/Ordnance program could proceed to the range airdrop phase.

TABLE 12 - COMPARISON OF MISSILE/ORDNANCE
STATIC DROP RESULTS AND TRANSPORTATION DESIGN LIMITS

PAYLOAD	DESIGN LIMITS		STATIC DROP RESULTS	
	g's	Milliseconds	g's	Milliseconds
Standard Arm	30	30	14.9	108
Shrike	25	30	14.7	118
M-46 Torpedo	60	>8	17.8	80
AN/SSQ-36 (light) Sonobuoys	100	11	44.6	58
AN/SSQ-50 (heavy) Sonobuoys	100	11	17.1	87

5.3 RANGE TESTS

5.3.1 Wallops Island

The objectives of these tests of A-7A, A-22, and Heavy Airdrop Platform Loads made up of A-22 Modules were to:

(1) Test load integrity through extraction, parachute deployment, and splashdown;

(2) Test sea painter deployment; and

(3) Develop initial aircraft flight pattern and communications.

All these objectives were successfully achieved. With the concurrence of the OPTEVFOR and Air Force observers, it was concluded the NEACDS should be continued into air drops to Fleet Units at sea.

5.3.2 Salton Sea

The objectives of the Salton Sea Airdrops for missile/ordnance loads were to:

(1) Develop additional load rigging documentation for Army Field Manuals;

(2) Train Air Force air crews in NEACDS flights and communications procedures; and

(3) Obtain additional shock data.

These objectives were all successfully realized. The shock levels of the Salton Sea Airdrops confirmed the splashdown shock data obtained during NHWC static drops. During these tests, the M1 Ground Release proved to be unreliable for water impact when winds were nine knots or less. Only three out of twelve releases functioned properly during the Salton Sea Tests. It was thought that a change in rigging the M1 Release would solve this problem and that otherwise these loads were ready for sea trials.

5.4 FLEET TRIALS

The NEACDS Fleet Trials were made under CNO Development Assist, Project number DV-118 with an "A" priority. Commander, Operational Test and Evaluation Force (COMOPTEVFOR), assigned a Project Officer to NEACDS to schedule fleet assets, assist in test plan development, interface with operational units, observe the tests, and report the results from an operational point-of-view. The Fleet Trials were scheduled as part of Fleet Training Exercises whenever possible to provide realistic conditions. The several NEACDS Fleet Tests were considered successful. Of twenty-three loads dropped, one A-7A was lost because the parachute failed to open; three loads required over an hour to retrieve (3.16, 1:46 and 1:06 hrs:mins); and one six-pack came apart in the water and required 55 minutes from load exiting the aircraft until completion of the retrieval process. The consensus of ship operators was that the feasibility of NEACDS was successfully demonstrated. Several ships recommended that a helicopter could be used as the retrieval instrument rather than requiring the ship to come dead-in-water. The parachute releases for light (A-7A/A-22) loads are basically unreliable. It was concluded that further development and testing of parachute releases was required to improve reliability.

OPTEVFOR's report[13] concluded:

> a. "These tests further substantiated the potential utility of the NEACDS concept of emergency cargo delivery.
>
> b. As deployment of the retrieval line during load descent is critical to normal load acquisition by the ship, better reliability of this deployment is required.
>
> c. Load retrieval time, as demonstrated under generally ideal conditions, could be marginal to unsatisfactory, depending on operational conditions assumed to exist.
>
> d. Additional development and testing is warranted."

---

[13] "Second Partial Report on Initial Operational Test and Evaluation of NEACDS (OPNAV Report Symbol 3960-12)," COMOPTEVFOR Ser 113, (14 February 1977).

SECTION 6
RECOMMENDATIONS

The feasibility of NEACDS has been demonstrated in an operational environment and a limited capability is available for use. To implement this capability it is recommended that:

(1) Publication and distribution of the required Army/Air Force FM/TOs be implemented by the U.S. Army QM School, Ft. Lee, VA.;

(2) Draft OPNAVINST 3180.XX be published and distributed to Naval Facilities and Fleet Units having roles in NEACDS implementation;

(3) The Joint Letter of Agreement be signed by the Navy, Army, and Air Force specifically defining the roles of each in the application of NEACDS;

(4) As an interim measure, the A-7A loads be overwrapped before final rigging with a light canvas painted with an international orange reflective paint to improve load visibility; and

(5) When the opportunity is available, the use of sea-water igniting flares such as the MK-25 should be investigated.

Project technical personnel feel that additional formal RDT&E on NEACDS is not warranted; rather, the operators should use it and incorporate their findings, i.e., NEACDS will evolve faster into a practical tool in the hands of the operational forces.

Several areas require additional formalized development:

(1) Load retrieval by helicopter - The Naval Air Test Center is presently pursuing Phase III (at sea trials). Phases I and II are reported by References 7 and 8, respectively.

(2) A Light Load Parachute Ground release is being developed by the US Army Natick Research and Development Center. A Procurement Package will be prepared by NARADCOM upon acceptance of the ground release by the Army.

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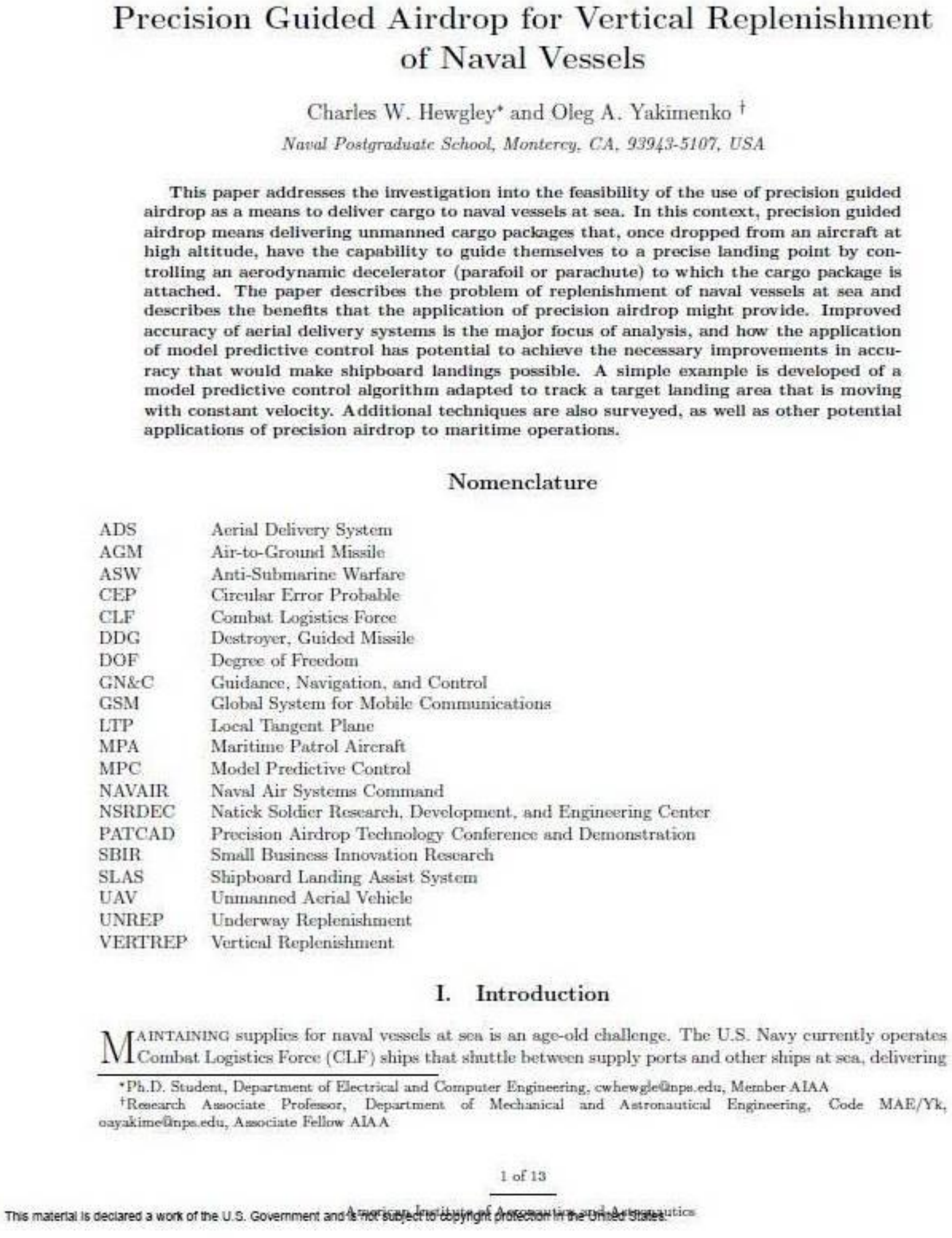
ANEXO C – *"PRECISION GUIDED AIRDROP FOR VERTICAL REPLENISHMENT OF NAVAL VESSELS"*



Precision Guided Airdrop for Vertical Replenishment of Naval Vessels

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This paper addresses the investigation into the feasibility of the use of precision guided airdrop as a means to deliver cargo to naval vessels at sea. In this context, precision guided airdrop means delivering unmanned cargo packages that, once dropped from an aircraft at high altitude, have the capability to guide themselves to a precise landing point by controlling an aerodynamic decelerator (parafoil or parachute) to which the cargo package is attached. The paper describes the problem of replenishment of naval vessels at sea and describes the benefits that the application of precision airdrop might provide. Improved accuracy of aerial delivery systems is the major focus of analysis, and how the application of model predictive control has potential to achieve the necessary improvements in accuracy that would make shipboard landings possible. A simple example is developed of a model predictive control algorithm adapted to track a target landing area that is moving with constant velocity. Additional techniques are also surveyed, as well as other potential applications of precision airdrop to maritime operations.

Nomenclature

ADS	Aerial Delivery System
AGM	Air-to-Ground Missile
ASW	Anti-Submarine Warfare
CEP	Circular Error Probable
CLF	Combat Logistics Force
DDG	Destroyer, Guided Missile
DOF	Degree of Freedom
GN&C	Guidance, Navigation, and Control
GSM	Global System for Mobile Communications
LTP	Local Tangent Plane
MPA	Maritime Patrol Aircraft
MPC	Model Predictive Control
NAVAIR	Naval Air Systems Command
NSRDEC	Natick Soldier Research, Development, and Engineering Center
PATCAD	Precision Airdrop Technology Conference and Demonstration
SBIR	Small Business Innovation Research
SLAS	Shipboard Landing Assist System
UAV	Unmanned Aerial Vehicle
UNREP	Underway Replenishment
VERTREP	Vertical Replenishment

I. Introduction

MAINTAINING supplies for naval vessels at sea is an age-old challenge. The U.S. Navy currently operates Combat Logistics Force (CLF) ships that shuttle between supply ports and other ships at sea, delivering

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fuel and stores to each patrolling ship at least once every two weeks. This process is known as "Underway Replenishment", or "UNREP." UNREP operations are expensive to plan and execute, and can be executed on the order of days, not hours, for an unforeseen need. Precision guided airdrop delivery capability can potentially make available a rapid and inexpensive means to get items out to a ship underway. This capability would be especially useful for high-value items that are needed quickly before the next scheduled CLF visit, such as aviation parts to repair helicopters and unmanned aerial vehicles (UAVs). Precision guided airdrop capability might also provide means to have mail delivered more frequently to ships underway.

Time-critical and unplanned deliveries to ships today are often conducted using "Vertical Replenishment," or "VERTREP," a subset of UNREP that is a method of delivering cargo to ships using rotary winged aircraft, including landing slung loads on the ship's flight deck. The VERTREP is a well-understood and often-practiced technique in the U.S. Navy today; therefore, this paper will apply some of the fundamentals of rotary-winged flight operations in the VERTREP process to the idea of using precision airdrop.

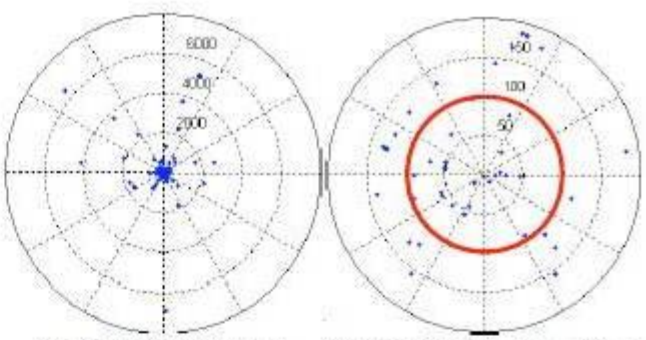
Critical performance factors of precision airdrop that will determine its suitability for shipboard deliveries include landing accuracy, and the landing descent rate onto the ship's flight deck. U.S. Navy ships conduct flight operations while steaming on a fairly constant heading during the landing phase; therefore, a key component of landing accuracy will be the capability of the aerial delivery system to track and reach a moving landing area. Also, whereas some aerial delivery systems achieve improved accuracy by using a higher descent rate, and shock-absorbing material to protect the cargo, the descent rate upon landing on a ship's flight deck should be quite limited. For these reasons, and, adopting the terminology introduced in Ref. 1, systems of the "low-glide" type, such as round parachutes, were rejected in favor of "mid-glide" types, such as parafoils, with a better glide ratio for moving target tracking. Also, for controlled rate of descent for shipboard landing, a guided parafoil was chosen over other classes of aerial delivery systems for this investigation. In fact, previous research has been done in the use of parafoils for shipboard landing. One previous experiment detailed in Ref. 2 studied the use of a parafoil to aid the landing of a UAV under power onto a representative helicopter flight deck area.

Continued improvements in the accuracy of precision airdrop systems has been both the motivation for, and an objective of this investigation. Until now, the prospect of delivering cargo to ships at sea using precision airdrop might not have deserved serious consideration due to the achievable accuracy that has been demonstrated. Recently, it is due to the continuing efforts of the U.S. Army Natick Soldier Research, Development, and Engineering Center (NSRDEC) that the accuracy of payload delivery has been improving drastically.[3,4] Numerous systems in different weight categories, such as those below 150 lbs, 500 lbs, 2000 lbs, 5,000 lbs, 10,000 lbs, and up to 30,000 lbs, have been developed and demonstrated at a series four biennial Precision Airdrop Technology Conferences and Demonstrations (PATCADs) at the U.S. Army Yuma Proving Ground, Yuma, Arizona, since 2001. A similar series of events has been held in Europe near Toulouse, France since 2001.

The most recent PATCAD was conducted in October 2007. During that event, 19 state-of-the-art cargo delivery systems were demonstrated. In figure 1, a very general comparison is made between the aggregate results of PATCAD 2007, and some recent flight test results of a system called "Snowflake" being developed jointly between the Naval Postgraduate School in Monterey, California, and the University of Alabama, Huntsville. The composite plots of the PATCAD 2007 results are shown in figures 1a and 1b.[5] Specifically, the distance in meters and bearing in degrees to the actual point of impact relative to the desired target impact point for 103 drops of all the cargo delivery systems across the spectrum of weight classes is presented in figure 1a. The desired target location is at the origin of each polar plot, with range rings representing miss distances in meters, and red circles showing approximate circular error probable (CEP).

Many of the demonstrated systems were still in the development process at the time of this event; consequently, there were some drops during which the given aerial delivery system (ADS) did not perform as expected. The impact locations outside the 2,000 m ring in figure 1a illustrate this point. In order to get a better understanding of the accuracy of current systems, the best 40% of the 103 drops conducted during PATCAD 2007 were chosen and plotted in figure 1b. The 50% CEP is plotted for this set as a red ring that contains half of the data set inside, and the other half outside. From this plot, it was estimated that the average accuracy of current systems is approximately 100 m CEP.

Recent developments in miniature payload delivery systems with increasingly sophisticated control algorithms show even more promise. For instance, figures 1c, 1d, and 1e show the performance of the Snowflake ADS. The first flight tests of this system were conducted in May 2008, at Camp Roberts, California, and demonstrated an accuracy of 55 m CEP as shown in figure 1c.[6] Upon analyzing the results of this test, it was



(a) PATCAD 2007, all drops (b) PATCAD 2007, best 40% of drops

(c) Snowflake ADS, TNT 08-3, May 2008, Camp Roberts, CA (d) Snowflake ADS, October 2008, Yuma Proving Grounds, AZ (e) Snowflake ADS, TNT 09-2, February 2009, Camp Roberts, CA

Figure 1: Comparison of PATCAD 2007 results with recent Snowflake flight test results

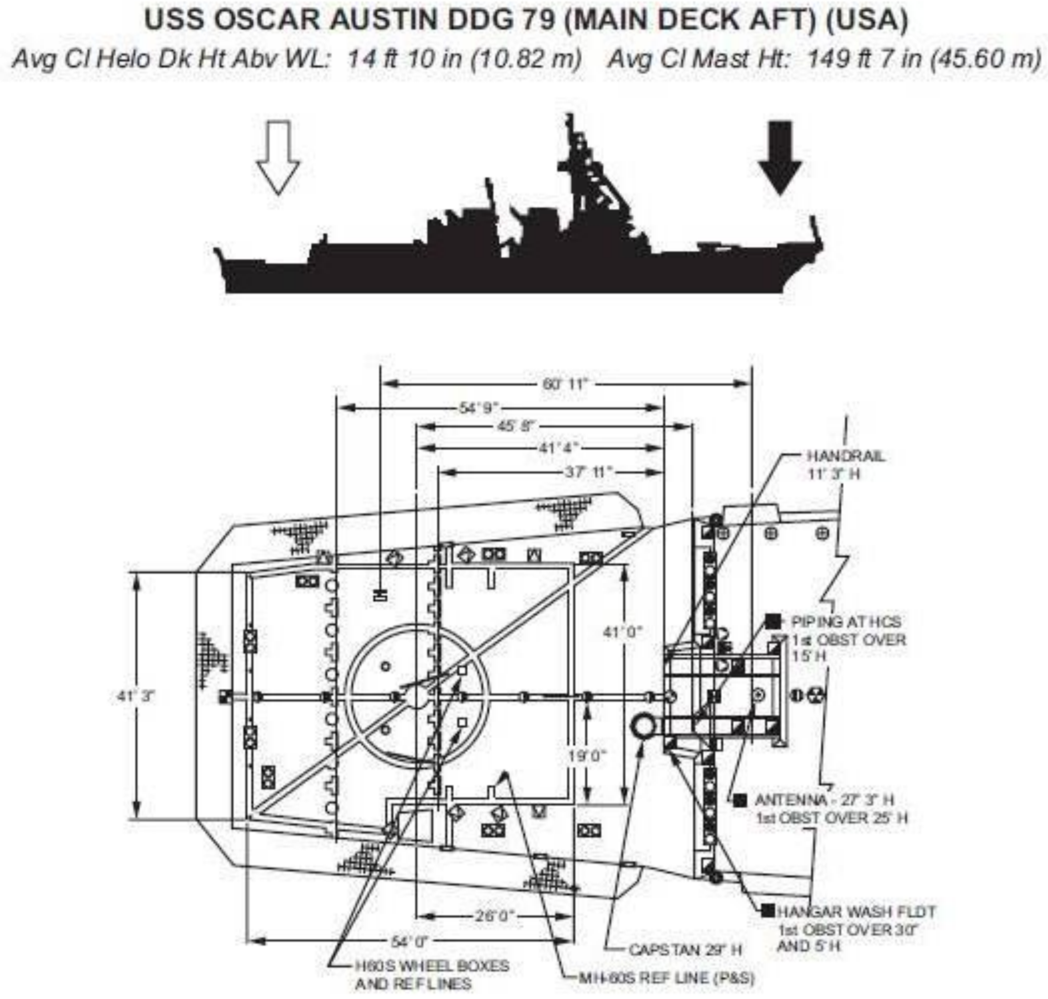
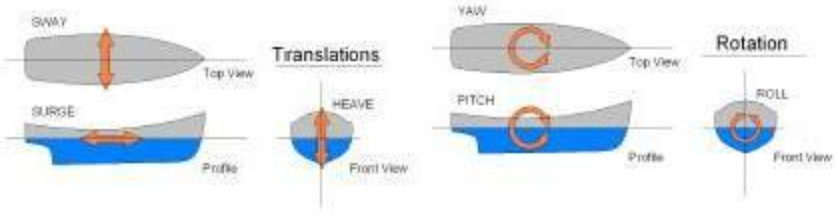


Figure 3: Landing area of USS OSCAR AUSTIN (DDG 79)

motion along three orthogonal axes. These translational and rotational motions with respect to the body axes of a ship are depicted in figure 4.



(a) Translations (b) Rotations

Figure 4: Definition of terms for ship three-axis translational and rotational motion

For the very simple model of the motion of the landing platform, it was assumed that the target ship was underway in relatively calm seas. The condition chosen is known as sea state 3, and is characterized by waves less than 1 m in height. It was assumed that the translational motion of the landing area platform would affect the ADS landing the most; therefore, the motion of the landing platform was modeled in sway and yaw only. Both of these motions were modeled as sinusoidal and having a 15 s period, with the amplitude of sway chosen to be 0.3 m, and the amplitude of yaw chosen to be 0.15°, as shown in equations 1 and 2.[a] Note that, in addition to these motions, the height of the landing platform above the sea surface was chosen to be 10.8 m in accordance with the information presented in figure 3. In order to complete the simple model of the target ship, it was assumed that the ship was steaming directly into the prevailing winds at a speed of 8 kts.

$$\text{sway} = 0.3\ \text{m} \times \sin\left(\frac{2\pi}{15\ \text{s}}t\right) \tag{1}$$

$$\text{yaw} = 0.15^\circ \times \sin\left(\frac{2\pi}{15\ \text{s}}t\right) \tag{2}$$

For the model of the ADS, a 6 degree-of-freedom (DOF) MATLAB representation of the Snowflake was used. Snowflake is a much smaller ADS than would actually be used for this situation; the purpose of choosing this model was to use it as a simple platform on which the model predictive control (MPC) algorithm could be modified to seek a trajectory to a moving target, and some initial results evaluated. The size and speed parameters of the Snowflake ADS are shown in table 1, and an image of this system is shown in figure 5.

Table 1: Snowflake ADS size and speed characteristics.

Parameter	Value
mass	1.95 kg
forward speed	7.2 m/s [14 kts]
descent rate	3.66 m/s
glide ratio	2

The approach of this ADS to a moving target, using the MPC algorithm described in Ref. 9, was simulated using MATLAB. Since the forward speed of the Snowflake as listed in table 1 is only 14 kts, and the target ship was modeled as having a constant speed of 8 kts, the simulations were run with zero wind relative to a local tangent plane (LTP) coordinate system. The MPC algorithm was modified so that the MPC calculations were made to produce an optimal trajectory to a landing point with a constant velocity of 8 kts relative to the LTP coordinate system.

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[a] simple formulae obtained via email from Naval Surface Warfare Center, Carderock Division, Seakeeping Division

(a) (b)

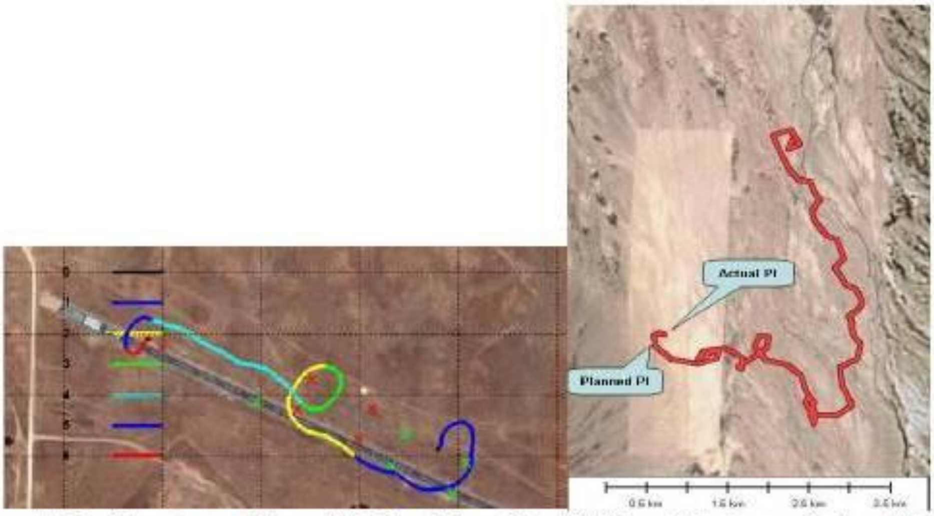
Figure 5: Snowflake Aerial Delivery System

The MPC algorithm causes the ADS to follow a repeatable, predictable trajectory relative to the target during the final approach phase. A predictable trajectory in this phase is advantageous for the application of shipboard landing because it allows the approach of the ADS to the ship to be designed to fit well with current shipboard flight operations procedures.[10] Figure 6 shows a comparison between the trajectories of the Snowflake ADS during a recent flight test in February, 2009, and the trajectory of the Sherpa 1200 ADS during one of the drops during PATCAD 2007. The Snowflake trajectory shown in figure 6a shows the first part of the trajectory, denoted by a blue line, from the drop location to a holding pattern (delimited by red "x" markers). Then, Snowflake executes one half-turn in holding (yellow line), followed by the set-up to approach (green line), the approach turn (cyan line), and the final approach to landing (red line). In contrast, the trajectory flown by the Sherpa ADS shown in figure 6b is much less predictable.

A complete description of the MPC algorithm that Snowflake uses to compute the setup and final approach turn is given in Ref. 9; however, in general terms, the algorithm includes the following steps:

1. The desired amount of time that Snowflake will spend on the final, straight approach to landing must be set by the user. This quantity is labeled T_{app}.
2. The algorithm then calculates the altitude, z_f, and the coordinate x_f at which the final, straight approach must begin, based on an assumed constant steady-state descent rate that is known before flight.
3. The radius R of the final approach turn must also be set by the user.
4. The algorithm then calculates the amount of time T_{turn} that will be spent in the turn, and also the altitude z_0 at which the approach turn must begin.
5. Based on the assumed constant speed of the target ship, the algorithm calculates the distance D_{switch} past the position directly abeam the target ship.
6. In flight, once the Snowflake has reached the position that is D_{switch} past the abeam position, it calculates an optimal approach turn that executes a change in heading of 180°, and terminates at the final coordinates x_f and z_f, where the straight approach to landing will be executed. The computed trajectory is optimal in the sense that it minimizes a cost function that includes deviation from the prescribed time in the turn T_{turn}, and use of excessive yaw rate. In Ref. 9, the optimization routine was designed to overcome the effect of wind on the final approach turn; but for this simulation, wind was set to zero, and the routine was instead tuned to track a target point moving with constant velocity.

In summary, the controller for this model has perfect knowledge of the moving target's location, and the target's constant velocity. The controller also has perfect knowledge of the current position, velocity,



(a) Snowflake trajectory, February, 2009, Camp Roberts, CA (b) Sherpa 1200 trajectory, October, 2007, Yuma, CA

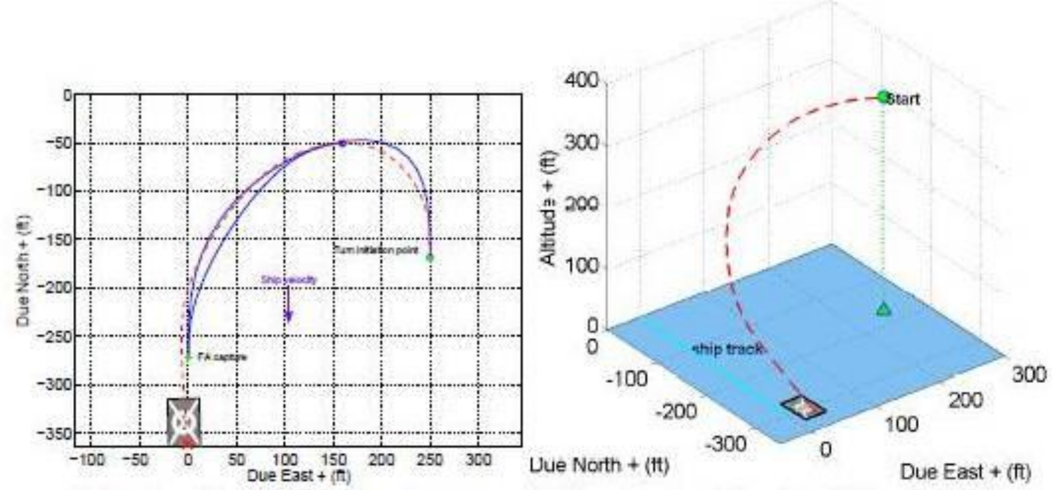
Figure 6: Comparison of trajectories of Snowflake and Sherpa aerial delivery systems

and orientation of the parafoil. Also, the controller is given values for steady state horizontal and vertical velocities of the parafoil. The controller does not have information on the sway and yaw motion of the target landing area.

III. Results

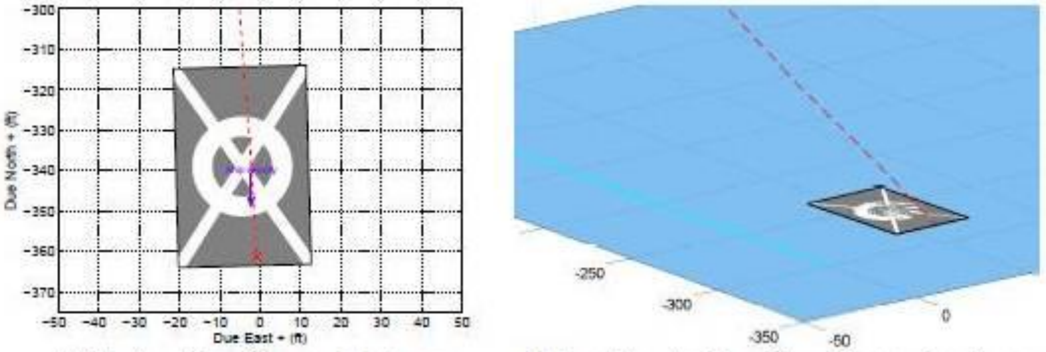
Using the MATLAB model of the control algorithm and the dynamics of the Snowflake ADS, it was found that the control algorithm could indeed be modified to execute an approach turn and final straight approach to landing to a target moving with constant velocity. As stated in Section II, the model used was very simple in that it did not contain random disturbances such as wind. Since each run of the simulation was identical, the results presented here show only one trial. Figure 7a shows the plan view of the approach turn and final straight approach to the landing area. Figure 7b shows a three-dimensional view of this trajectory. The final location of the ship's landing area is depicted in each plot, with the ship's displacement in sway and yaw incorporated into the drawing of the platform.

Figure 7a shows that in the simulation, the Snowflake ADS landed on the far forward edge of the landing area. One possible reason for this overshoot is that the actual time taken for the approach turn may have been less that that originally estimated by the controller when the optimal trajectory was calculated. Overshoot of this sort could be corrected easily with the incorporation of a control method to use both parafoil trailing edge control surfaces as flaps for a flared landing. In this current model, only differential, or aileron control input is used. Figure 8a shows a close-up view of the landing area, and figure 8b shows a close-up three-dimensional view of the landing area, with the location of the parafoil touchdown indicated.



(a) Plan view of Snowflake approach trajectory (b) Three dimensional view of Snowflake approach trajectory

Figure 7: Snowflake approach trajectory to a moving target



(a) Plan view of Snowflake approach trajectory (b) Three dimensional view of Snowflake approach trajectory

Figure 8: Expanded view of Snowflake approach trajectory

IV. Enhancement to Precision Airdrop for VERTREP

In order to achieve further improvements in the accuracy of precision airdrop systems so that consistent shipboard landings may be accomplished, additional communications links or sensors may need to be integrated into the guidance, navigation, and control (GN&C) packages that will be used. One such technique that is already in use to assist shipboard landing of rotary-wing aircraft is automatic data communication. The target ship's current position and current observed winds across the flight deck would be two streams of information that would be very useful to the algorithms in the GN&C package. In fact, this idea is the focus of current research involving the Snowflake-N ADS.[8] In these experiments, the Snowflake-N ADS receives in-flight updates of target position and ground winds using a mobile telephone communications link on the Global System for Mobile Communications (GSM) network.

Another technique that could assist in the final approach to landing phase is optical tracking of the landing area using visible light or infrared sensors. Previous investigation conducted at the Naval Postgraduate School into the use of infrared sensors for autonomous UAV shipboard landing showed that a UAV could determine its orientation with respect to the ship using three reference points in an infrared image of the target ship.[11] Furthermore, video image tracking techniques that have been proven in weapon systems such as AGM-62 Walleye and AGM-65 Maverick could be employed to maintain a precise tracking lock on the center of the flight deck landing area.

One recent additional technique that has been tested to aid autonomous recovery of manned rotary-wing aircraft is the incorporation of a laser rangefinder mounted near the flight deck landing area. As part of the development of the new SH-60K patrol helicopter for the Japanese Maritime Self-Defense Force, an autonomous landing of a manned SH-60K aboard ship was demonstrated through the use of the Ship Landing Assist System (SLAS). The automatic control algorithms in SLAS incorporated information from a laser rangefinder aboard the ship that tracked a reflective marker on the helicopter in range and azimuth as shown in figure 9.[12] This technique could also be applied to aid in the landing of a precision airdrop system.

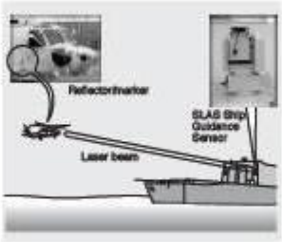


Figure 9: Use of a laser rangefinder

The preceding discussion has yet to address one of the most fundamental questions of employing precision airdrop at sea: "what if the cargo misses the target?" For further development of this concept, detailed consideration should be given to algorithms in the GN&C package that try to determine in flight whether an on-deck landing is either impossible or unsafe, perhaps due to high risk of collision with the ship's superstructure. In the case that the ADS and cargo do not land on the flight deck, and hit the sea surface instead, it might prove worth the extra weight and complexity to incorporate a flotation system into the ADS.

V. Other Maritime Applications of Precision Airdrop

Cargo delivery is only one of many potential application of precision airdrop technology to the maritime environment. Whereas the discussion above has centered on landing cargo on a cooperative target ship underway, this idea could also be extended to landing a small payload aboard a non-cooperative target ship. Potential applications of this concept include landing small sensor and tracker payloads on commercial shipping in order to detect certain types of material aboard a vessel, or to enable constant tracking of a particular vessel. Miniature, high-accuracy aerial delivery systems have the potential to land their payloads aboard ships undetected to accomplish these functions.

The next two maritime applications of precision airdrop are related to anti-submarine warfare (ASW), and are being investigated in conjunction with the development of the U.S. Navy's next-generation maritime patrol aircraft (MPA), the P-8 Poseidon. Unlike its predecessor, the P-3 Orion, the P-8 is designed to conduct its search, localize, track, and attack mission from high altitude. Because MPA rely on sensors and weapons dropped from the aircraft into the sea, i.e. sonobuoys and torpedoes, the higher operating altitude of the P-8 necessitates a greater need for accuracy in these airdrops. All current sonobuoy and torpedo systems now include aerodynamic decelerator systems in order limit the velocity of the sonobuoy or torpedo before it hits the sea surface; in the future, these aerodynamic decelerators may have the additional function of providing a high level of accuracy to the airdrop.

The Naval Air Systems Command (NAVAIR) is the agency in the U.S. Navy responsible for development and procurement of aircraft-deployed sensor and weapon systems. A previous NAVAIR study on improving the accuracy of sonobuoys launched from high altitude had listed two improvements that could improve the accuracy of high-altitude sonobuoy drops: improved wind prediction using rawinsondes, and delayed deployment of the sonobuoy's aerodynamic decelerator.[13] In December 2007, the Program Manager, Air (PMA) 264 Air Anti-Submarine Warfare Program management office issued a research solicitation through the U.S. Government's Small Business Innovation Research (SBIR) program to study techniques for increasing the accuracy of landing for sonobuoys dropped from high altitude.[14] The name given to this solicitation was Precision High Altitude Sonobuoy Employment (PHASE); a general illustration of the concept is shown in figure 10. The requirements imposed upon the techniques included:

- Deployment altitude: 20,000 to 30,000 feet above ground level
- Spash Point Accuracy: 500 m required / 100 m desired
- Maximum Descent Time: 300 seconds from 30,000 feet
- Guidance: GPS cannot be utilized

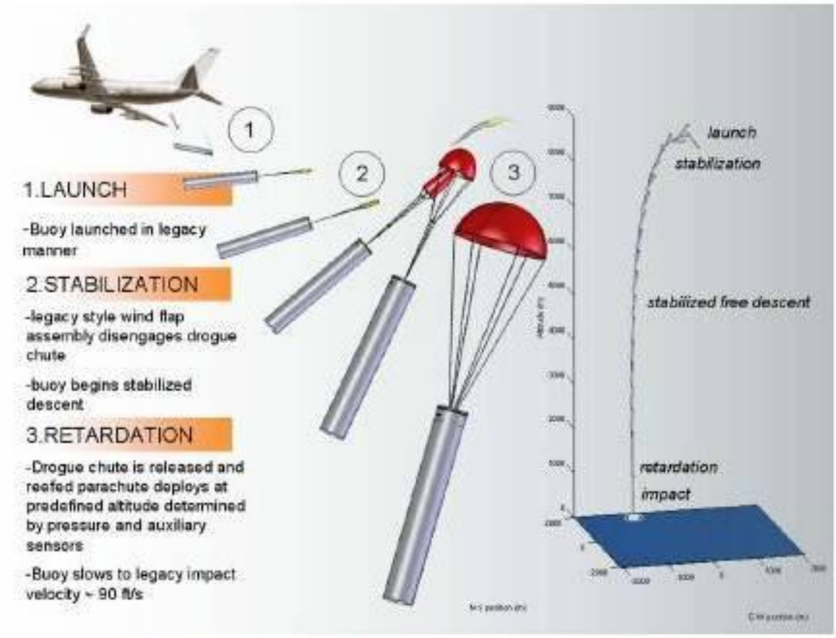


Figure 10: Precision High Altitude Sonobuoy Employment (PHASE) concept

At first glance, a high-velocity, two-stage decelerator might be best suited to this task, since a key performance parameter for a sonobuoy is speed of deployment. Of the technical reports that were submitted to NAVAIR in October, 2008, two reports reviewed did indeed focus on high-velocity, multiple-stage decelerator systems, where an initial drogue parachute or reefed main parachute stabilized the sonobuoy during the majority of the descent, and a second-stage parachute system was used at low altitude to slow the sonobuoy to the required impact velocity.[15,16] Most likely due to the requirement stated in the SBIR solicitation that the Global Positioning System (GPS) satellite navigation system could not be used to perform guidance on the sonobuoys, precision guidance to a desired splash point was not one of the functions of the aerodynamic decelerator system detailed in these reports. The exclusion of GPS was likely due to concerns about compatibility with the current generation of sonobuoys, which do not have an integral GPS receiver. Nevertheless, future generations of sonobuoys will almost certainly incorporate GPS, and a low or mid-glide parachute or parafoil system might be suitable for the tasks of terminal deceleration and guidance to a precise splash point, using navigation information received by the sonobuoy.

For the application of precision airdrop to the employment of torpedoes, NAVAIR's PMA-264 Air Anti-Submarine Warfare Program management office awarded a contract to Lockheed Martin in June 2006 under the name High Altitude Anti-Submarine Warfare Weapons Concept (HAAWC). The contact was for demonstration of a system that allowed a torpedo to be dropped from an aircraft at high altitude, while being able to achieve high accuracy to a desired splash point. In May, 2007, Lockheed Martin successfully demonstrated a drop of a Mk-54 lightweight ASW torpedo (about 800 lbs) from a P-3 Orion MPA.[17] The torpedo was released at an altitude above 8,000 ft, and flew to the desired water entry point using a set of foldable fixed wings attached to the torpedo body. It is logical that speed of employment of a torpedo is even more important than glide-ratio for a high-altitude drop, because it is assumed that the MPA can, at high altitude, fly over or near the location of the submarine. Therefore, a high-velocity, two-stage system might be better suited for the task of providing precision guidance to high-altitude torpedo drops. Like the case of the sonobuoy, the tasks of terminal deceleration and guidance to a precise splash point might be accomplished using a guided parafoil as the second stage of a two-stage system.

VI. Conclusion

From this investigation, it was concluded that precision airdrop systems do have the potential to be used for vertical replenishment of naval vessels, provided further improvements in accuracy can be made. Along with improvements that can be made to precision airdrop systems for maritime vertical replenishment, and additional applications for other maritime missions, there is certainly ample ground for further research.

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