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FINAL REPORT
 EMI INSTRUMENTATION
 REQUIRED FOR
 THE EMCARD PROGRAM

REPORT NO. 79114
 28 SEPTEMBER 1979

PREPARED FOR:
 Naval Air Development Center
 Warminster, PA
 Contract No. N62269-79-M-6496

PREPARED BY:
 R & B Enterprises
 Plymouth Meeting, PA

Robert D. Goldblum
 Robert D. Goldblum
 President

**IF YOU HAVE OR CAN FIND REQ'D INSTRUMENTS
 PLEASE CONTACT JOE LANNON X3109
 JOE SEGREST X2722**

R & B ENTERPRISES Division of Robar Industries Inc.
 P.O. BOX 328 Plymouth Meeting, Pa. 19462 (215) 828-6236

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FOREWORD

This is the final report of Contract Number N62269-72M-6496. It contains the results of an effort to define MEC/EMI instrumentation required for the Navy's EMCARD program and MIL-STD-461A and 462 evaluations. The period of work performance under the contract extended from 13 Sept. 79 to 28 Sept. 79.

This report has been prepared to satisfy CDRL Data Item No. 1 following the format stated in A-5029.

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SECTION I

1.0 INTRODUCTION

The objective of this program is to determine the EMI instrumentation required by the Navy for testing in its EMCARD program and for MIL-STD-461A and MIL-STD-462 evaluations. This involved an inventory of available EMI instrumentation at NADC and research into the EMI instrumentation commercially available that will fulfill the stated requirements. The data has been compiled in tables from which recommendations have been made for the procurement of specific items. Costs (including GSA prices, when applicable) and delivery time have been included.

2.0 SUMMARY

Approximately 30 manufacturers of EMI test instrumentation and devices required in EMI test configuration have been contacted. The products of 25 of these manufacturers have been deemed appropriate for use in EMI and related tests. The required test equipment has been found to be commercially available with delivery dates generally ranging from stock to 6 months. In some limited cases, 12 month deliveries have been quoted. The only equipment not available as off-the-shelf equipment is the power amplification and radiation system required to produce 200V/M over the frequency ranges of 10kHz to 27GHz.

Tables have been developed showing the available EMI test instrumentation and products versus the applicable test requirements of MIL-STD-461A. A separate table is included for the test equipment required for MIL-HDBK-248 radiation hazards measurements.

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3.0 CONCLUSIONS

The EMI test instruments and products recommended for purchase by NADC have been divided into two categories: recommended bare minimum, and recommended preferred. These are presented in Tables 4 and 5 of Section II. The bare minimum includes the use of current NADC instrumentation, the manual operation of the instruments, limited redundancy in current probes and other devices, and limited back-up systems. The preferred list includes automatic operation of instrumentation, reasonable redundancy of certain products, and the availability of back-up and analysis equipment.

The current costs for the equipment are as follows:

Bare Minimum:

Preferred:

The costs represent current catalogue prices, GSA documents, where applicable, and many are substantiated by written quotes. It should be noted, however, that the prices are generally valid only for 90 days, and are subject to change at a later date.

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SECTION II

1. INTRODUCTION

This section includes a completed and detailed list of the recommended bare minimum and preferred EMI test equipment. It also describes the basis upon which the recommendations were made and other considerations.

2. OVERVIEW OF TABLES

2.1 TABLE 1

Table 1 is a list of EMI test instruments and products available to perform measurements to the requirements of MIL-STD-461A, Notices 1 and 2 per MIL-STD-462, Notices 1 and 2. In the preparation of this table, some preselection has been made, especially for products for which there are numerous sources, such as 10uf test capacitors. Cost, delivery and experience with the manufacturers' products were considerations in the preselection process.

The table shows the applicable MIL-STD-461/2 test method for which each product is required. It should be noted that a product may be applied on more than one test method in many cases.

The last column in Table 1 is the current price and delivery schedule for the corresponding product. Special GSA prices are shown, where applicable. These are all current prices taken from current price lists, and, in many cases, substantiated by written quotations. These quotations are retained in R & B Enterprises' files.

The number in the bracket following each manufacturer listed in the first column of Table 1 corresponds to the list of manufacturers shown in Table 6.

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2.2 TABLE 2

Table 2 is the list of EMI test instrumentation and products currently available at the Naval Air Development Center (NADC) in Warminster, PA. The equipment listed in this table forms the nucleus of the equipment which has been designated as bare minimum shown in Table 4. It also is a major part of extended capabilities offered by AILTECH as shown in Table 3.

2.3 TABLE 3

AILTECH has offered to modify NADC's existing NM-17/27 and NB-37/57 at no charge to make it part of complete automated receiving system. The additional equipment which must be purchased to complete this system is shown in Table 3. It should be noted that both Hewlett-Packard and Tektronix equipment form part of the AILTECH system.

The total price shown in Table 3 is \$166,112. This may be reduced substantially by deleting the extended range to 40GHz feature, FC-67, which costs \$50,000. However, AILTECH still wants to include the NM-67 receiver covering the frequency range of 1 to 18 GHz.

2.4 TABLE 4

Table 4 presents a list of recommended EMI test instrumentation and products which should be added to the current inventory of NADC equipment, as a bare minimum, in order to perform tests to most of the applicable requirements of MIL-STD-461A. It assumes that the entire testing operation will be manual, that there will be no duplication of products, such as current probes, antennas, etc. and that there will be no back-up system. The cost for this additional equipment is

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2.5 TABLE 5

Table 5 presents a list of recommended equipment which a fully equipped EMI test facility should have in order to perform EMI evaluations to MIL-STD-461/2. The automated features of this equipment provide considerable time and cost savings in the performance of the tests and the data reduction processes. It is not to be misconstrued as a "cadillac" facility since more expensive and complex measurement systems than those recommended exist.

2.6 TABLE 6

Equipment manufacturers which appear in all of the other tables of this report are consolidated and presented in Table 6. The addresses and telephone numbers are provided for the home offices. A comprehensive listing of local sales offices and sales representatives can be found in ITEM, EEM or other such directories.

2.7 TABLE 7

The prime sources of RF radiation hazard instrumentation are listed in Table 7, along with the measuring devices. The recommended device, manufactured by General Microwave is identified.

2.8 TABLE 8

The generation of 200 V/M across the radio spectrum of 10 kHz to 27 GHz is a very difficult and expensive proposition. Thus, the additional test equipment required to generate, radiate and measure these fields are separated and listed in Table 8.

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3.0 DISCUSSION

The following discussion highlights some of the philosophy used in selecting the test equipment. Table 1 presents a large selection of EMI test instrumentation and products which are available. Tables 4 and 5 show the equipment which has been selected from Table 1.

The test instrumentation and products which NADC should have as a bare minimum are shown in Table 4. Even with this test equipment, there will still be tests per MIL-STD-461 for which equipment still is missing. The tests which cannot be performed are:

CS03

CS04

CS05

RE06

RS04

The reason these tests were omitted was in consideration of cost and the low frequency and priority in performing these tests. If it is desired to instrument to perform these tests, the required test equipment is shown in Table 1 and recommended in Table 5. RE06 instrumentation is not specified since it pertains to overhead power lines.

Special devices which must be built by the test laboratory, such as a long wire antenna, parallel plate, hand-held probes, etc. are not included. Other small devices, such as a step-down transformer, variac, etc. are not included since they are widely available, non-specialized and relatively low in cost.

The test instrumentation and products which the test facility should have to perform all tests per MIL-STD-461 are shown in Table 5. Whereas Table 4 assumes the use of present NADC

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equipment (Table 2), specifically, the Singer EMI receivers, Table 5 recommends the purchase of the Electro-Metrics' receiving system. The cost of upgrading the current system as shown in Table is approximately the same as the cost of the Electro-Metrics' system. Thus, the new acquisition provides redundancy and a back-up system at practically no additional cost.

The use of a spectrum analyzer to perform measurements above 1GHz is the preferred approach. The analyzer provides adequate sensitivity and very broad frequency coverage. It is also a useful tool in resolving interference problems, and provides some redundancy with the receivers.

The radiation hazard meter (Table 7) serves two functions. One is to perform measurement per MIL-HDBK-248, and secondly, to measure the RS03 field strengths above 200MHz. The field sensors will measure the RS03 fields below 200MHz. Thus, an extra set of antennas is not required and the receivers are free for other parallel tests.

The generation of 200 volts per meter from 10kHz to 27GHz is very expensive and involves unproven test methods. Table 8 is a list of test equipment currently identified for this type of test. Logimetrics has indicated that their system will provide the required fields. However, additional studies are recommended in this area prior to the committment of funds.

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TABLE 1: TEST EQUIPMENT FOR TESTING TO MIL-STD-461A/462, NOTICES 1 and 2 (Continued)

MANUFACTURER	EQUIPMENT	MODEL	FREQUENCY RANGE	TEST METHOD	PRICE & DELIVERY
HEWLETT-PACKARD (7)	AMPLIFIER	489A	1GHz to 2GHz		\$3850. 9 wks
	AMPLIFIER	491C	2GHz to 4GHz		\$3850. "
	AMPLIFIER	493A	4GHz to 8GHz		\$4200. "
	AMPLIFIER	495A	7GHz to 12.4GHz		\$4200. "
NARDA (14)	TWO-WAY POWER DIVIDER	3324-2	2 to 8GHz		\$225 1 wk.
	" "	3326-2	6 to 18GHz		\$350 10 wks.
SOLAR (11)	LOW PASS FILTER	6623-0.1	0 to 0.1MHz		\$295 4 "
	"	6623-0.2	0 to 0.2MHz		\$295 4 "
	"	6623-0.5	0 to 0.5MHz		\$295 4 "
	"	6623-1.0	0 to 1.0MHz		\$295 4 "
	"	6623-2.0	0 to 2.0MHz		\$295 4 "
	"	6623-5.0	0 to 5.0MHz		\$295 4 "
	"	6623-10	0 to 10MHz		\$295 4 "
	"	6623-20	0 to 20MHz		\$295 4 "
	"	6623-30	0 to 30MHz		\$295 4 "
	"	6623-50	0 to 50MHz		\$295 4 "
	"	6623-100	0 to 100MHz		\$295 5 "
HEWLETT-PACKARD(?)	FREQUENCY COUNTER	5342A-H10	10Hz to 24GHz		\$4850
TEKTRONIX (15)	OSCILLOSCOPE, D. T. STORAGE	7613	0 to 100MHz		\$3430 16 "
	OSCILLOSCOPE, PLUG-IN AMPLIF.	7A26	0 to 200MHz, Dual		\$1435 6 "
	" " TIME BASE	7B53A			\$1135 8 "
	OSC. CART Model 3	Model 3			\$375. 2 "
OSCILLOSCOPE CAMERA	C-53P			\$1225	
AMERICAN ELECTRONIC LABS, INC. (24)	ANTENNA	ASN-1232	200 to 1000MHz		\$680 1 wk.
HEWLETT-PACKARD(7)	ATTENUATOR	8491B-010	DC - 18GHz		\$95

TABLE 1: TEST EQUIPMENT FOR TESTING TO

MIL-STD-461A/462, NOTICES 1 and 2

(Continued)

MANUFACTURER	EQUIPMENT	MODEL	FREQUENCY RANG	TEST METHOD																PRICE & DELIVERY																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
HEWLETT-PACKARD (7)	DIGITAL VOLT-METER	3435A	10kHz to 700MHz	CE01	CE02	CE03	CE04	CE05	CE06	CE01	CE02	CE03	CE04	CE05	CE06	CE07	CE08	RE01	RE02	RE03	RE04	RE05	RE01	RE02	RE03	RE04	RE05	RE06	RE07	RE08	RE09	RE10	RE11	RE12	RE13	RE14	RE15	RE16	RE17	RE18	RE19	RE20	RE21	RE22	RE23	RE24	RE25	RE26	RE27	RE28	RE29	RE30	RE31	RE32	RE33	RE34	RE35	RE36	RE37	RE38	RE39	RE40	RE41	RE42	RE43	RE44	RE45	RE46	RE47	RE48	RE49	RE50	RE51	RE52	RE53	RE54	RE55	RE56	RE57	RE58	RE59	RE60	RE61	RE62	RE63	RE64	RE65	RE66	RE67	RE68	RE69	RE70	RE71	RE72	RE73	RE74	RE75	RE76	RE77	RE78	RE79	RE80	RE81	RE82	RE83	RE84	RE85	RE86	RE87	RE88	RE89	RE90	RE91	RE92	RE93	RE94	RE95	RE96	RE97	RE98	RE99	RE100	RE101	RE102	RE103	RE104	RE105	RE106	RE107	RE108	RE109	RE110	RE111	RE112	RE113	RE114	RE115	RE116	RE117	RE118	RE119	RE120	RE121	RE122	RE123	RE124	RE125	RE126	RE127	RE128	RE129	RE130	RE131	RE132	RE133	RE134	RE135	RE136	RE137	RE138	RE139	RE140	RE141	RE142	RE143	RE144	RE145	RE146	RE147	RE148	RE149	RE150	RE151	RE152	RE153	RE154	RE155	RE156	RE157	RE158	RE159	RE160	RE161	RE162	RE163	RE164	RE165	RE166	RE167	RE168	RE169	RE170	RE171	RE172	RE173	RE174	RE175	RE176	RE177	RE178	RE179	RE180	RE181	RE182	RE183	RE184	RE185	RE186	RE187	RE188	RE189	RE190	RE191	RE192	RE193	RE194	RE195	RE196	RE197	RE198	RE199	RE200	RE201	RE202	RE203	RE204	RE205	RE206	RE207	RE208	RE209	RE210	RE211	RE212	RE213	RE214	RE215	RE216	RE217	RE218	RE219	RE220	RE221	RE222	RE223	RE224	RE225	RE226	RE227	RE228	RE229	RE230	RE231	RE232	RE233	RE234	RE235	RE236	RE237	RE238	RE239	RE240	RE241	RE242	RE243	RE244	RE245	RE246	RE247	RE248	RE249	RE250	RE251	RE252	RE253	RE254	RE255	RE256	RE257	RE258	RE259	RE260	RE261	RE262	RE263	RE264	RE265	RE266	RE267	RE268	RE269	RE270	RE271	RE272	RE273	RE274	RE275	RE276	RE277	RE278	RE279	RE280	RE281	RE282	RE283	RE284	RE285	RE286	RE287	RE288	RE289	RE290	RE291	RE292	RE293	RE294	RE295	RE296	RE297	RE298	RE299	RE300	RE301	RE302	RE303	RE304	RE305	RE306	RE307	RE308	RE309	RE310	RE311	RE312	RE313	RE314	RE315	RE316	RE317	RE318	RE319	RE320	RE321	RE322	RE323	RE324	RE325	RE326	RE327	RE328	RE329	RE330	RE331	RE332	RE333	RE334	RE335	RE336	RE337	RE338	RE339	RE340	RE341	RE342	RE343	RE344	RE345	RE346	RE347	RE348	RE349	RE350	RE351	RE352	RE353	RE354	RE355	RE356	RE357	RE358	RE359	RE360	RE361	RE362	RE363	RE364	RE365	RE366	RE367	RE368	RE369	RE370	RE371	RE372	RE373	RE374	RE375	RE376	RE377	RE378	RE379	RE380	RE381	RE382	RE383	RE384	RE385	RE386	RE387	RE388	RE389	RE390	RE391	RE392	RE393	RE394	RE395	RE396	RE397	RE398	RE399	RE400	RE401	RE402	RE403	RE404	RE405	RE406	RE407	RE408	RE409	RE410	RE411	RE412	RE413	RE414	RE415	RE416	RE417	RE418	RE419	RE420	RE421	RE422	RE423	RE424	RE425	RE426	RE427	RE428	RE429	RE430	RE431	RE432	RE433	RE434	RE435	RE436	RE437	RE438	RE439	RE440	RE441	RE442	RE443	RE444	RE445	RE446	RE447	RE448	RE449	RE450	RE451	RE452	RE453	RE454	RE455	RE456	RE457	RE458	RE459	RE460	RE461	RE462	RE463	RE464	RE465	RE466	RE467	RE468	RE469	RE470	RE471	RE472	RE473	RE474	RE475	RE476	RE477	RE478	RE479	RE480	RE481	RE482	RE483	RE484	RE485	RE486	RE487	RE488	RE489	RE490	RE491	RE492	RE493	RE494	RE495	RE496	RE497	RE498	RE499	RE500	RE501	RE502	RE503	RE504	RE505	RE506	RE507	RE508	RE509	RE510	RE511	RE512	RE513	RE514	RE515	RE516	RE517	RE518	RE519	RE520	RE521	RE522	RE523	RE524	RE525	RE526	RE527	RE528	RE529	RE530	RE531	RE532	RE533	RE534	RE535	RE536	RE537	RE538	RE539	RE540	RE541	RE542	RE543	RE544	RE545	RE546	RE547	RE548	RE549	RE550	RE551	RE552	RE553	RE554	RE555	RE556	RE557	RE558	RE559	RE560	RE561	RE562	RE563	RE564	RE565	RE566	RE567	RE568	RE569	RE570	RE571	RE572	RE573	RE574	RE575	RE576	RE577	RE578	RE579	RE580	RE581	RE582	RE583	RE584	RE585	RE586	RE587	RE588	RE589	RE590	RE591	RE592	RE593	RE594	RE595	RE596	RE597	RE598	RE599	RE600	RE601	RE602	RE603	RE604	RE605	RE606	RE607	RE608	RE609	RE610	RE611	RE612	RE613	RE614	RE615	RE616	RE617	RE618	RE619	RE620	RE621	RE622	RE623	RE624	RE625	RE626	RE627	RE628	RE629	RE630	RE631	RE632	RE633	RE634	RE635	RE636	RE637	RE638	RE639	RE640	RE641	RE642	RE643	RE644	RE645	RE646	RE647	RE648	RE649	RE650	RE651	RE652	RE653	RE654	RE655	RE656	RE657	RE658	RE659	RE660	RE661	RE662	RE663	RE664	RE665	RE666	RE667	RE668	RE669	RE670	RE671	RE672	RE673	RE674	RE675	RE676	RE677	RE678	RE679	RE680	RE681	RE682	RE683	RE684	RE685	RE686	RE687	RE688	RE689	RE690	RE691	RE692	RE693	RE694	RE695	RE696	RE697	RE698	RE699	RE700	RE701	RE702	RE703	RE704	RE705	RE706	RE707	RE708	RE709	RE710	RE711	RE712	RE713	RE714	RE715	RE716	RE717	RE718	RE719	RE720	RE721	RE722	RE723	RE724	RE725	RE726	RE727	RE728	RE729	RE730	RE731	RE732	RE733	RE734	RE735	RE736	RE737	RE738	RE739	RE740	RE741	RE742	RE743	RE744	RE745	RE746	RE747	RE748	RE749	RE750	RE751	RE752	RE753	RE754	RE755	RE756	RE757	RE758	RE759	RE760	RE761	RE762	RE763	RE764	RE765	RE766	RE767	RE768	RE769	RE770	RE771	RE772	RE773	RE774	RE775	RE776	RE777	RE778	RE779	RE780	RE781	RE782	RE783	RE784	RE785	RE786	RE787	RE788	RE789	RE790	RE791	RE792	RE793	RE794	RE795	RE796	RE797	RE798	RE799	RE800	RE801	RE802	RE803	RE804	RE805	RE806	RE807	RE808	RE809	RE810	RE811	RE812	RE813	RE814	RE815	RE816	RE817	RE818	RE819	RE820	RE821	RE822	RE823	RE824	RE825	RE826	RE827	RE828	RE829	RE830	RE831	RE832	RE833	RE834	RE835	RE836	RE837	RE838	RE839	RE840	RE841	RE842	RE843	RE844	RE845	RE846	RE847	RE848	RE849	RE850	RE851	RE852	RE853	RE854	RE855	RE856	RE857	RE858	RE859	RE860	RE861	RE862	RE863	RE864	RE865	RE866	RE867	RE868	RE869	RE870	RE871	RE872	RE873	RE874	RE875	RE876	RE877	RE878	RE879	RE880	RE881	RE882	RE883	RE884	RE885	RE886	RE887	RE888	RE889	RE890	RE891	RE892	RE893	RE894	RE895	RE896	RE897	RE898	RE899	RE900	RE901	RE902	RE903	RE904	RE905	RE906	RE907	RE908	RE909	RE910	RE911	RE912	RE913	RE914	RE915	RE916	RE917	RE918	RE919	RE920	RE921	RE922	RE923	RE924	RE925	RE926	RE927	RE928	RE929	RE930	RE931	RE932	RE933	RE934	RE935	RE936	RE937	RE938	RE939	RE940	RE941	RE942	RE943	RE944	RE945	RE946	RE947	RE948	RE949	RE950	RE951	RE952	RE953	RE954	RE955	RE956	RE957	RE958	RE959	RE960	RE961	RE962	RE963	RE964	RE965	RE966	RE967	RE968	RE969	RE970	RE971	RE972	RE973	RE974	RE975	RE976	RE977	RE978	RE979	RE980	RE981	RE982	RE983	RE984	RE985	RE986	RE987	RE988	RE989	RE990	RE991	RE992	RE993	RE994	RE995	RE996	RE997	RE998	RE999	RE1000	RE1001	RE1002	RE1003	RE1004	RE1005	RE1006	RE1007	RE1008	RE1009	RE1010	RE1011	RE1012	RE1013	RE1014	RE1015	RE1016	RE1017	RE1018	RE1019	RE1020	RE1021	RE1022	RE1023	RE1024	RE1025	RE1026	RE1027	RE1028	RE1029	RE1030	RE1031	RE1032	RE1033	RE1034	RE1035	RE1036	RE1037	RE1038	RE1039	RE1040	RE1041	RE1042	RE1043	RE1044	RE1045	RE1046	RE1047	RE1048	RE1049	RE1050	RE1051	RE1052	RE1053	RE1054	RE1055	RE1056	RE1057	RE1058	RE1059	RE1060	RE1061	RE1062	RE1063	RE1064	RE1065	RE1066	RE1067	RE1068	RE1069	RE1070	RE1071	RE1072	RE1073	RE1074	RE1075	RE1076	RE1077	RE1078	RE1079	RE1080	RE1081	RE1082	RE1083	RE1084	RE1085	RE1086	RE1087	RE1088	RE1089	RE1090	RE1091	RE1092	RE1093	RE1094	RE1095	RE1096	RE1097	RE1098	RE1099	RE1100	RE1101	RE1102	RE1103	RE1104	RE1105	RE1106	RE1107	RE1108	RE1109	RE1110	RE1111	RE1112	RE1113	RE1114	RE1115	RE1116	RE1117	RE1118	RE1119	RE1120	RE1121	RE1122	RE1123	RE1124	RE1125	RE1126	RE1127	RE1128	RE1129	RE1130	RE1131	RE1132	RE1133	RE1134	RE1135	RE1136	RE1137	RE1138	RE1139	RE1140	RE1141	RE1142	RE1143	RE1144	RE1145	RE1146	RE1147	RE1148	RE1149	RE1150	RE1151	RE1152	RE1153	RE1154	RE1155	RE1156	RE1157	RE1158	RE1159	RE1160	RE1161	RE1162	RE1163	RE1164	RE1165	RE1166	RE1167	RE1168	RE1169	RE1170	RE1171	RE1172	RE1173	RE1174	RE1175	RE1176	RE1177	RE1178	RE1179	RE1180	RE1181	RE1182	RE1183	RE1184	RE1185	RE1186	RE1187	RE1188	RE1189	RE1190	RE1191	RE1192	RE1193	RE1194	RE1195	RE1196	RE1197	RE1198	RE1199	RE1200	RE1201	RE1202	RE1203	RE1204	RE1205	RE1206	RE1207	RE1208	RE1209	RE1210	RE1211	RE1212	RE1213	RE1214	RE1215	RE1216	RE1217	RE1218	RE1219	RE1220	RE1221	RE1222	RE1223	RE1224	RE1225	RE1226	RE1227	RE1228	RE1229	RE1230	RE1231	RE1232	RE1233	RE1234	RE1235	RE1236	RE1237	RE1238	RE1239	RE1240	RE1241	RE1242	RE1243	RE1244	RE1245	RE1246	RE1247	RE1248	RE1249	RE1250	RE1251	RE1252	RE1253	RE1254	RE1255	RE1256	RE1257	RE1258	RE1259	RE1260	RE1261	RE1262	RE1263	RE1264	RE1265	RE1266	RE1267	RE1268	RE1269	RE1270	RE1271	RE1272	RE1273	RE1274	RE1275	RE1276	RE1277	RE1278	RE1279	RE1280	RE1281	RE1282	RE1283	RE1284	RE1285	RE1286	RE1287	RE1288	RE1289	RE1290	RE1291	RE1292	RE1293	RE1294	RE1295	RE1296	RE1297	RE1298	RE1299	RE1300	RE1301	RE1302

TABLE 2

EMI TEST EQUIPMENT CURRENTLY AVAILABLE AT NADC

DESCRIPTION	MODEL	MANUFACTURER
EMI Field Intensity Meter	NM-17/27	Singer Stoddard
EMI Field Intensity Meter	NB-37/57	Singer Stoddard
41" Rod Antenna	92197-3	Singer
Antenna Coupler	94592-1	Singer
Bi-Conical Antenna	7825	Honeywell
Bi-Conical Antenna	BCA-902	Honeywell
Conical Log Spiral Antenna	93490-1	Singer
Current Probe	91550-1	Stoddard
Tripod	91933-2	Singer
Transmission Cable, 20"	92191-1	Singer
H-Y Recorder	7047A	Hewlett-Pickard
Line Stabilization Networks (3)	- -	- -
Loop Probe	90799-3	Singer
Impulse Generator	IG-115	Empire Devices

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TABLE 3
 AILTECH EQUIPMENT REQUIRED TO EXTEND
 CAPABILITIES OF PRESENT NADC EQUIPMENT

MANUFACTURER	EQUIPMENT	MODEL	UNIT PRICE	TOTAL PRICE	DELIVERY
AILTECH	CONTROL UNIT	CP-7	\$25,000	\$25,000	18 weeks
	20Hz - 50kHz	NM-7A	9,560	9,560	12 "
	1-18GHz	NM-67	44,000	44,000	30 "
	Extend range to 40GHz; price not to exceed	FC-67			
			50,000	50,000	1 year
	INPUT SWITCH w. atten.	CIV-7	5,900	5,900	30 weeks
HEWLETT-PACKARD	CALCULATOR	9825F	9,000	9,000	18 "
	DIGITAL PLOTTER	9862.015	3,980	3,980	18 "
TEKTRONIX	OSCILLOSCOPE		3,400	3,400	18 "
AILTECH	LOOP ANTENNA 5½"d./NM-7	94605-1	235	235	12 "
	B.B. ANTENNA Preamp/Coupler	94607-1	500	500	8 "
	Biconical Antenna 20-200MHz	94455-1	595	595	8 "
	Log Periodic Antenna, 1-18GHz	94612-1	750	750	26 "
	Curr. Probe 20Hz-8MHz	91197-1	205	205	10 "
	Curr. Probe 1MHz-1GHz	94111-1	300	300	10 "
	Curr. Probe 20Hz-50MHz	93686-2	295	295	10 "
	BNC to N ADAPTER (2 ea.)	11663	6.50 ea.	13.	10 "

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TABLE 3 (Cont'd.)

MANUFACTURER	EQUIPMENT	MMODEL	UNIT PRICE	TOTAL PRICE	DELIVERY	
AILTECH	CABLE 6', N-N	90933-6	\$ 75	\$ 75	10 weeks	
	CABLE 20', N-N 2 ea.	90933-8	100	200	10 "	
	CABLE 20' BNC-BNC	92191-1	45	45	10 "	
	PROGRAM CABLE, 6'-4 ea.	94595-1	320	1280	10 "	
	CABLE RF to VIDEO 8 ea.	94596-1	33	254	10 "	
	CONTROL CABLE	94604-1	175	175	10 "	
	CABLE-IEEE-488 10'	94618-2	185	185	10 "	
	Cable -IEEE to Calculator	98034A	470	470	10 "	
	TRIPOD ADAPTER, 2 ea.	91932	95	190	10 "	
	TRIPODS, 2 ea.	91933-2	210	420	10 "	
	GROUND PLANE	92199-3	90	90	10 "	
	HEADPHONES	10796-2	33	33	10 "	
	2 BAY CONSOLE/ DECK/STORAGE DRAWER (WIRED)		2700	2700	10 "	
	ROLLAWAY CABINET WIRED FC67		1200	1200	10 "	
	WAVEGUIDE for 18GHz-40GHz Ant.		300	300	10 "	
	18-40GHz Ant.		750	750	10 "	
	HORN ANTENNA KIT, 1-18GHz	94623-1	3575	3575	10 "	
	HORN TRANSIENT CASE, 2 ea.	94621-1	225	450	10 "	
		TOTAL PRICE			\$166,112	

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TABLE 4
RECOMMENDED ADDITIONAL EQUIPMENT
(BARE MINIMUM)

QUANTITY	MANUFACTURER	EQUIPMENT	MODEL	TOTAL PRICE
1	TENSOR (3)	ANTENNA	4105	\$1250
1	AILTECH (4)	CURRENT PROBE	91197-1	\$205
1	SOLAR (11)	CAPACITOR	7525-1	\$36.50
4		10MFD CAPACITOR	6512-106R	\$240.
2		ISOLATION XFMR	7032-1	\$200
1		AUDIO ISOLATION XFMR	6220-1A	\$165
1		SPIKE GENERATOR	7054-1	\$1450
1		0.5 ohm RESISTOR	6920-0.5	\$88
1		AMPLIFIER	6552-1A	\$750
1	HEWLETT-PACKARD (7)	ATTENUATOR	355D	\$255
1		SIGNAL SOURCE	8616A	\$4950
1		" "	618C	\$5850
1		" "	620B	\$5850
1		" "	626A	\$8650
1		" "	628A	\$8650
1		DIGITAL VOLTMET.	3435A	\$400
1		RF PROBE	11096	\$90
1		AMPLIFIER	489A	\$3850
1		"	491C	\$3850
1		"	493C	\$4200.
1	WAVETEK (8)	SIGNAL SOURCE	166	\$1695
1		" "	2002	\$3400
1	IFI (16)	FIELD SENSOR	EFS-1	\$545

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TABLE 4 (Continued)

QUANTITY	MANUFACTURER	EQUIPMENT	MODEL	TOTAL PRICE
1	AMPLIFIER RESEARCH (17)	LEVEL AMP	777	\$950
1		AMPLIFIER	100L	\$6700
1		"	10W1000	\$4900
1	HUGHES (21)	AMPLIFIER	1177H17	\$7695
1	BIRD ELECTRONICS (22)	ATTENUATOR	8329	\$890
1		DUMMYLOAD	8251	\$340
1		COAX SWITCH	7431	\$170
1	NARDA (14)	DIRECT. COUPLER	3000-20	\$200
1		"	3001-20	\$200
1		"	3002-20	\$200
1		"	3003-20	\$200
1		"	3004-20	\$250
1		"	3039-20	\$425
1	MICROLAB (23)	POWER DIVIDER	DA-3FN	\$55
1	ELECTRO-METRICS (2)	NOTCH FILTER	NRG-10	\$410
1		" "	NRF-10	\$860
1		TUNABLE REJ. FILTERS	TRF-13	\$4200
1		" "	TRF-14	\$3700
1		" "	TRF-15	\$3400
1	GENERAL MICROWAVE (25)	METER	4	\$1250
1	HEWLETT-PACKARD (7)	SPECTRUM ANALYZER	141T	\$2600
1		IF SECTION	8552B	\$4025
1		RF SECTION	8553B	\$3350
1		" "	8555A	\$8100
1		PRE-SELECTOR	8445B	\$3930
TOTAL COST				\$110,434.50

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TABLE 5
RECOMMENDED ADDITIONAL EQUIPMENT
(PREFERRED)

QUANTITY	MANUFACTURER	EQUIPMENT	MODEL	UNIT PRICE	TOTAL PRICE
1	TENSOR	ANTENNA	4104	\$485	\$485
1		ANTENNA	4101	\$495	\$495
1		ANTENNA	4105	\$1250	\$1250
1	ELECTRO-METRICS	CURRENT PROBE	PCL-10	\$300	\$300
1			PCL-25	\$305	\$305
1		RECEIVER SYSTEM	CCS-125	\$74,795	\$74,795
2	HEWLETT-PACKARD	SIGNAL SOURCE	200CD	\$730	\$1460
2		"	204D	\$540	\$1080
2		"	606B	\$4500	\$9000
2		"	608E	\$5800	\$11,600
2		"	612A	\$4650	\$9,300
2		"	8614A	\$4950	\$9,900
2		"	8616A	\$4950	\$9,900
2		"	618C	\$5850	\$11,700
2		"	620B	\$5850	\$11,700
2		"	626A	\$8650	\$17,300
2		"	628A	\$8650	\$17,300
1	SOLAR	TRANSFORMER	6220-1A	\$99.50	\$99.50
1		CAPACITOR	7525-1	\$36.50	\$36.50
4		FEEDTHRU	6512-106R	\$59.50	\$238

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QUANTITY	MANUFACTURER	EQUIPMENT	MODEL	UNIT PRICE	TOTAL PRICE
1	HEWLETT-PACKARD (7)	ATTENUATOR	355D	\$255	\$255
1		ATTENUATOR	355C	\$255	\$255
2	NARDA (14)	ATTENUATOR	771-6	\$40	\$80
1	HEWLETT-PACKARD (7)	DIGITAL VOLT METER	3435A	\$400	\$400
1		RF Probe	11096	\$90	\$90
1	IFI (16)	FIELD SENSOR	EFS-1	\$545	\$545
1		LIGHT TX	LMT	\$495	\$495
1		LIGHT RX	LDI	\$495	\$495
1	SOLAR (11)	SIGNAL SOURCE	6254-1	\$845	\$845
1		AMPLIFIER	6552-1A	\$750	\$750
1	AMPLIFIER RESEARCH (17)	AMPLIFIER	100 L	\$6700	\$6700
1		AMPLIFIER	10WT000	\$4900	\$4900
1	HUGHES (21)	AMPLIFIER	1177H09	\$5640	\$5640
1		AMPLIFIER	1177H01	\$5640	\$5640
1		AMPLIFIER	1177HC2	\$5640	\$5640
1		AMPLIFIER	1177H17	\$7695	\$7695
1	ELECTRO-METRICS (2)	NOTCH FILTER	NRG-10	\$410	\$410
1		NOTCH FILTER	NRF-10	\$860	\$860
2	SOLAR (11)	ISOLATION TRANSFORMER	7032-1	\$100	\$200

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QUANTITY	MANUFACTURER	EQUIPMENT	MODEL	UNIT PRICE	TOTAL PRICE
1	ELECTRO-METRICS	CURRENT PROBE AMP.		\$425	\$425
1		TUNABLE REJECTION FILT.	TRF-11		
1			TRF-12		
1			TRF-13		
1			TRF-14		
1			TRF-15		\$17,000
1		HIGH PASS FILTER	HPK-10	\$595	\$595
1		"	HPL-10	\$450	\$450
1	BIRD ELECTRONICS	POWER ATTENUA- TOR (1kw)	8329	\$890	\$890
1	SOLAR	PHASE SHIFT NETWORK	7021-1	\$350	\$350
1	BIRD ELECTRONICS	DUMMY LOAD, 1kW	8251	\$340	\$340
2	NARDA	ATTENUATOR, 20W	768-3	\$140	\$280
2		ATTENUATOR, 20W	768-10	\$140	\$280
1	BIRD ELECTRONICS	COAX SWITCH	7431	\$170	\$170
1	NARDA	COAX DIRECTIONAL COUPLER, 500W 20dB	3000-20	\$200	\$200
1		"	3001-20	\$200	\$200
1		"	3002-20	\$200	\$200
1		"	3003-20	\$200	\$200
1		"	3004-20	\$250	\$250
1		"	3039-20	\$425	\$425

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TABLE 5 (Continued)

QUANTITY	MANUFACTURER	EQUIPMENT	MODEL	UNIT PRICE	TOTAL PRICE
1	MICROLAB (23)	POWER DIVIDER 2 Watt	DA-3FN	\$55	\$55
1	SOLAR (11)	LLOOP SENSOR	7334-1	\$195	\$195
1		RESISTOR, NON-INDUCTIVE	6920-0.5	\$88	\$88
1		"	6815-1	\$185	\$185
1		TWO-WAY POWER DIVIDER	3324-2	\$225	\$225
1	NARDA (14)		3326-2	\$350	\$350
2	SOLAR (11)	LOW PASS FILTER	6623-0.1	\$295	\$590
2		"	6623-0.2	\$295	\$590
2		"	6623-0.5	\$295	\$590
2		"	6623-1.0	\$295	\$590
2		"	6623-2.0	\$295	\$590
2		"	6623-5.0	\$295	\$590
2		"	6623-10	\$295	\$590
2		"	6623-20	\$295	\$590
2		"	6623-30	\$295	\$590
2		"	6623-50	\$295	\$590
2		"	6623-100	\$295	\$590
1	HEWLETT-PACKARD (7)	FREQUENCY COUNTER	5342A-H10	\$4850	\$4850
1	TEKTRONIX (15)	OSCILL., D.T. STORAGE	7613	\$3430	\$3430
1		OSCILL., PLUG- IN AMPLIF.	7A26	\$1435	\$1435
1		PLUG-IN TIME BASE	7B53A	\$1135	\$1135
1		OSCILL. CAMERA	C-53P	\$1225	\$1225

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(Continued)

QUANTITY	AMMANUFACTURER	EQUIPMENT	MODEL	UNIT PRICE	TOTAL PRICE
2	HEWLETT-PACKARD (7)	ATTENUATOR	8491B-010	\$95	\$190
1	AMERICAN ELECTRONIC LABS, INC. (24)	ANTENNA	ASN-1232	\$880	\$880
1	HEWLETT-PACKARD (7)	MAIN FRAME/ DISPLAY	141T	\$2600	\$2600
1		IF SECTION	8552B	\$4025	\$4025
1		RF SECTION	8556A	\$2525	\$2525
1		" "	8553B	\$3350	\$3350
1		" "	8555A	\$8100	\$8100
1		PRESELECTOR	8445B/002/ 003	\$3930	\$3930
1		STORAGE NORMALIZER	8750	\$1450	\$1450
1		OSCILLOSCOPE CAMERA	197B	\$1100	\$1100
1		EXTERNAL MIXER	11517A	\$275	\$275
1		WAVEGUIDE TAPER SECTIONS	11518A	\$175	\$175
1		" "	11519A	\$175	\$175
1		" "	11520A	\$175	\$175
1	GENERAL MICROWAVE (25)	METER	4	\$1250	\$1250
1	ELECTRO-METRICS (2)	ANTENNA	RVR-25	\$990	\$990
				TOTAL PRICE	\$303,247.00

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TABLE 6
EQUIPMENT MANUFACTURER
LOCATION

- | | |
|---|--|
| <p>(1) The Electro-Mechanics Co. (EMCO)
P. O. Box 1546
Austin, TX 78767
512-451-8273</p> | <p>(9) KROHN-HITE Corp.
Avon Industrial Park
Bodwell St.
Avon, MA 02322
617-580-1660</p> |
| <p>(2) Electro-Metrics
100 Church St.
Amsterdam, NY 12010
518-843-2600</p> | <p>(10) Genisco Technology Corp.
18435 Susana Rd.
Compton, CA 90221
213-537-4750</p> |
| <p>(3) Tensor, Inc.
P. O. Box 14843
Austin, TX 78761
512-837-4900</p> | <p>(11) Solar Electronics Co.
901 N. Highland Ave.
Hollywood, CA 90038
213-462-0806</p> |
| <p>(4) AILTECH
Los Angeles Operation
5340 Aila Rd.
Los Angeles, CA 90066
213-822-3061</p> | <p>(12) Captor Corporation
5040 S. County Rd. (25A)
Tipp City, OH 45371
513-667-8484</p> |
| <p>(5) Fischer Custom Communications
P. O. Box 581
Manhattan Beach, CA 90266
213-545-4617</p> | <p>(13) Filtron Mfg. Co., Inc.
148 Sweet Hollow Rd.
Old Bethpage, NY 11804
516-752-1144</p> |
| <p>(6) Watkins-Johnson Co.
700 Quince Orchard Rd.
Gaithersburg, MD 20760
301-948-7550</p> | <p>(14) Narda Microwave Corp.
75 Commercial St.
Plainview, NY 11803
516-433-9000</p> |
| <p>(7) Hewlett-Packard Co.
1021 Eight Ave.
King of Prussia, PA 19406
215-265-7000</p> | <p>(15) Tektronix, Inc.
P. O. Box 500
Beaverton, OR 97077
503-644-0161</p> |
| <p>(8) Wavetek
66 North First Ave.
Beech Grove, IN 46107
317-783-3211</p> | <p>(16) Instruments for Industry, Inc.
151 Toledo St.
Farmingdale, NY 11735
516-694-1414</p> |

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TABLE 6 (Cont'd.)

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|---|--|
| <p>(17) Amplifier Research Corp.
160 School House Rd.
Souderton, PA 18964
215-723-8181</p> <p>(18) Topaz Electronics
3855 Ruffin Rd.
San Diego, CA 92123</p> <p>(19) Berkeley Instruments, Inc.
2700 DuPont Dr.
Irvine, CA 92715</p> <p>(20) Electronic Navigation Industries, Inc.
3000 Winton Rd.
So. Rochester, NY 14623
716-473-6900</p> <p>(21) Hughes Aircraft Co.
Electron Dynamics Div.
3100 W. Lomita Blvd.
Torrance, CA 90509
213-534-2121</p> <p>(22) Bird Electronics Corp.
30303 Aurora Rd.
Solon, OH 44139
216-248-1200</p> <p>(23) Microlab/FXR
10M Microlab Rd.
Livingston, NJ 07031
201-992-7700</p> <p>(24) American Electronic Labs, Inc.
P. O. Box 552
Lansdale, PA 19446
215-822-2929</p> <p>(25) General Microwave Corp.
155 Marine St.
Farmingdale, NY 11735
516-694-3600</p> <p>(26) BEC Engineers, Inc.
625 Andover Park West
Tukwila, WA 98188
206-575-5772</p> | <p>(27) EPSCO Microwave
411 Providence Hwy.
Westwood, MA 02090
617-329-1500</p> <p>(28) Logimetrics, Inc.
121-03 DuPont St.
Plainview, NY 11803
516-681-4700</p> |
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TABLE 7
RADIATION HAZARD MONITORING INSTRUMENTS

MANUFACTURER	EQUIPMENT	MODEL	FREQUENCY RANGE	PRICE	DELIVERY
NARDA MICROWAVE (14)	METER	8608	0.01 to 26GHZ		
	PROBE	8621	0.3 to 26GHZ 10 to 300MHZ 0.3 to 26GHZ 10 to 300MHZ	\$3645	16 weeks
	PROBE	8631		\$1450	18 weeks
	PROBE	8623		\$975	12 weeks
PROBE	8633				
*GENERAL MICROWAVE(25)	METER	4	0.01 to 26GHZ	\$1250	26 weeks

*Recommended because of price.

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TABLE 8
EQUIPMENT FOR 200V/M SUSCEPTIBILITY TEST

MANUFACTURER	EQUIPMENT	MODEL	FREQUENCY RANGE	POWER	PRICE	DELIVERY
AMPLIFIER RESEARCH (17)	POWER AMPLIF.	AR2000L	10kHz to 220MHz	2kw	\$38,000	4 months
	"	AR900	10kHz to 100MHz	10kw	\$75,000	9 "
	"	AR200HA	220 to 400MHz	200W	\$15,900	4 "
EPSCO MICROWAVE (27)	POWER SOURCE	5233H/B3	450 to 950MHz	5kw Pulse	\$7000	8 weeks
	POWER AMPLIF.	A600/L	1 to 2GHz	200W	\$20,000	150 days
LOGIMETRICS (28)	"	A600/S	2 to 4 GHz	200W	\$18,500	" "
	"	A600/C	4 to 8GHz	200W	\$18,500	" "
	"	A600/X	8 to 12.4GHz	200W	\$19,000	" "
	"	A600/U	12.4 to 18GHz	100W	\$30,500	" "
AMPLIFIER RESEARCH (17)	ANTENNA	AT1000	150 to 1000MHz		\$1850	60 "
TENSOR (3)	RIDGED WG. ANT.	4105	1 to 12.4GHz		\$1250	90 days
AMERICAN ELECTRONIC LABS, INC. (24)	LOG PERIODIC ANTENNA					
	TEM TEST CELL		10kHz to 100MHz		\$1- 3,000,000	
BOEING (26)	200V/M SYSTEM COMPLETE-INSTALLED W/REMOTE CONTROL	1018R	10kHz to 27GHz	200V/M at 1 Meter	\$600,000	1 year
	200V/M SYSTEM COMPLETE-INSTALLED COMPUTER CONTROL W/SOFTWARE	1018C	10kHz to 27GHz	200V/M at 1 meter	\$850,000	1 year

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