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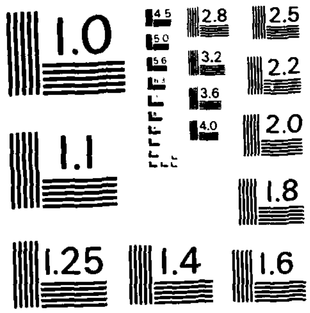

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NAVAL CIVIL ENGINEERING LABORATORY
Port Hueneme, California

Sponsored by
NAVY ENERGY & NATURAL RESOURCES
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EMCS INSTALLATION FOLLOW-UP STUDY
VOLUME I OF II

March 1984

An Investigation Conducted by
NEWCOMB & BOYD
One Northside 75, Ste 200
Atlanta, GA 30318

REQ3066-7880

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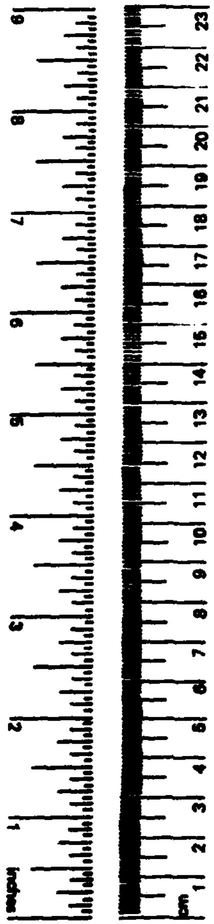
METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

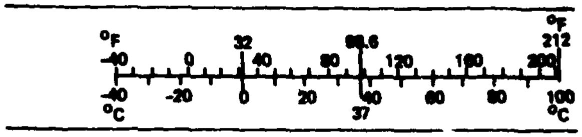
Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2,000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1,000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report documents the Kings Bay Master Plan/Feasibility Study for implementing EMCS and follow-up visits to selected sites. Probable causes for the success or failure of EMCS and possible cures are discussed.

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Table of Contents

1.0 INTRODUCTION

This report provides the Task 3 deliverables for an EMCS Installation Follow-Up study. The objective of this study is to provide data on experience at existing EMCS installations for use in developing guidelines for better implementation of EMCS. Task 1 of the study provides for review of data gathered in past studies. Task 2 of the study involves visiting sites included in those past studies to determine the effectiveness of corrective actions taken at those sites to improve EMCS performance. Task 3 summarizes the Task 1 and 2 findings and provides a report recommending actions to enhance the successful implementation of EMCS.

This study is being performed for the Navy Civil Engineering Laboratory, Port Hueneme, California, by Newcomb & Boyd Consulting Engineers, Atlanta, Georgia.

Section 2.0 of this report provides a list of probable causes for EMCS success/failure identified in previous studies. The previous studies were performed as part of a master plan/feasibility study for implementation of EMCS at the Kings Bay Submarine Base. The field investigation findings and recommendations from those studies are included in Appendices C and D of this report. These have been edited to be general in nature and to delete site specific data which is only applicable to the Kings Bay installation. Copies of the Site Visit Notes and Attachments from those Kings Bay studies are included in Appendices A and B to provide the background information for the findings and recommendations. All of the information included in the above listed sections has previously been included in the reports for the Kings Bay project, however since the Kings Bay reports were for a specific project, they received limited distribution. For that reason, this study repeats those findings so the current status of Navy EMCS projects may be compared to that of two years past and so that those readers not familiar with the Kings Bay reports may understand the starting point for this study.

Section 3.0 of this report discusses whether or not recommendations made in the Kings Bay study have been implemented and how effective those actions have been in addition to discussing areas not previously addressed. That evaluation is based on Site Visit Notes and Attachments included in Appendices E and F which document visits made as Task 2 of this study.

Section 4.0 provides a summary list of recommendations which are based on current conditions as found during the course of this project.

Section 5.0 provides Exhibits referenced in Section 1.0 through 4.0.

All Appendices are bound separately as Volume II of this report.

2.0 SUMMARY OF PAST INVESTIGATION FINDINGS/RECOMMENDATIONS

Listed below is a summary of factors identified in past studies which affect the success/failure of EMCS implementation. During site visits scheduled as Task 2 of this study, the importance of those factors and results of corrective actions taken has been investigated and is included in Section 3.0 of this report.

- User Involvement: The end users of the EMCS should be involved in the entire procurement process. Lack of user interest can cause EMCS failure.

- Continuity: The same organization and personnel should be involved thru each step of the procurement process to provide continuity.

- User Organizational Structure: The end user's organizational structure and the place of the EMCS within that structure should allow effective use of the EMCS. Navy Public Works organizations may have difficulty with this since the EMCS crosses many of the lines of responsibility that are traditionally part of those groups.

- Guide Specifications: A number of detailed comments regarding guide specifications were noted on the past site visits, those are included in Appendices A, B, C and D.

- Non-Proprietary Expandability: No EMCS project includes all points which may be desired to be connected to the system in the future. Provisions must be made to account for expansion of the EMCS and consideration of the proprietary problems of such expansion regarding connection to the existing system.

- Maintenance Strategy: Plans must be made for maintenance of the EMCS. This may use in-house or contract approaches but in either case is absolutely necessary for long term success of the system.

- Existing Field Conditions: Existing controls condition and interface problems have led to significant delays and claims during the construction process. A method for dealing with these conditions and problems must be found for successful implementation.

- Design Comments: A number of detailed comments regarding design practices were noted on past site visits and are included in Appendices A, B, C and D.

- Contractor Qualifications: Contractual mechanisms which discourage inexperienced, unqualified bidders on EMCS projects would reduce risks and problems encountered in past installations. Some contractural requirements such as "Small Business Set Aside" have had detrimental effects in this area.

- Bidding and Construction Schedules: Reasonable schedules should be contemplated based on the experience with existing EMCS projects.

- Software Rights: Proprietary software restrictions can cause difficulties in use of the systems, and can be particularly troublesome in competitive expansions or modifications.

- ROICC Technical Assistance: Government construction representatives may not have technical experience in EMCS installation. Sources of assistance should be available for those situations.

- Contract Interpretation: Varying interpretations of guide specification intent from project to project make uniform implemention of systems difficult for EMCS manufacturers.

- Submittals: A clear definition of what data is to be provided is needed on an EMCS contract. A plan for reviewing, approving or other use of the data is also needed.

- Testing: Detailed definition of tests to be performed must be included in the contract. Proper execution of the tests, both on the part of the contractor and the government, is also important for EMCS success.

- Progress Payments: Contractural procedures for progress payments should recognize the difference between hardware delivery/installation and actual performance and should place more incentive on performance than is found in a conventional construction contract.

- Staffing: Adequate staffing of the EMCS with interested, qualified and trained personnel is essential for successful implementation.

3.0 FOLLOW-UP FIELD INVESTIGATION FINDINGS:

As stated earlier, the purpose of this report is to identify actions which can improve the probability of success for EMCS projects. The method used is to visit EMCS installations and identify reasons for success/failure at those installations and, based on those factors, make recommendations to be followed on future projects. This effort is a follow-up to a similar study done in 1981 for the Kings Bay Submarine Base. One function of this study will be to identify whether or not the recommendations made by the Kings Bay study have been implemented and, if they have, have they been effective.

In order to evaluate the effectiveness of the Kings Bay Study, the findings of the follow-up investigation have been categorized along the lines of the Kings Bay recommendations. Each of those items will be discussed in this section and then additional areas not previously identified in the Kings Bay Study will be discussed.

3.1 USER INVOLVEMENT:

One of the prime reasons for success at the sites visited was a high degree of user involvement in the EMCS process. While involvement through the entire design/procurement process is desirable, the most effective involvement appears to be working closely with the contractor during the final months of the EMCS installation and during the start-up process. Where the user's organizations have taken that approach, the systems are clearly much more successful than at sites where the user did not participate until "final acceptance" of the system by the ROICC. Having heavy involvement in the installation and start-up of the system benefits both the using agency and the contractor. It provides the contractor with the necessary support to work cut some of the difficult final equipment connection problems while also educating the using personnel in use of and trouble shooting of the EMCS.

One phenomenon that has had a negative impact on user interest at some sites has been the recent flattening of fuel cost increases. In fact, some areas have experienced fuel oil cost reductions. Due to this, there seems to be much less emphasis on energy conservation and little Command commitment at some locations. Lack of comprehensive energy conservation policy or Navy-wide Command commitment hampers working level personnel in their effort to implement EMCS. Clearly there is a need for commitment to energy conservation at each site prior to beginning the EMCS project. This will be discussed further under "User Organizational Structure".

In some cases, user interest and involvement has been high at one point in a project, but due to circumstances or events beyond the user's control that interest has diminished. During the design process the user must be asked for his input to the system, but then once he gives input, that should be incorporated into the design. In some cases, the users made comments on the EMCS based on their knowledge of future events planned for the Base, but that input was ignored in the design process. In another case, the users had a high degree of interest at the time of EMCS contract award but because of numerous difficulties with the contractor and extremely long delays in completing the project, that interest has now turned to skepticism.

One way user involvement could be promoted during the long EMCS construction process would be to invite the users to attend and observe the factory test. This would give them a more direct feel for the capabilities of the system which they would be receiving. If this was done, a separate "show and tell" session should be arranged for the contractor to demonstrate his system to the users. This is necessary because the detailed and exhausting factory test process could overwhelm the user with detail without giving him a good overview of the system and its capabilities.

Another feature which could be specified to promote user involvement would be to provide a simulator panel in the Master Control Room which the user could spend substantial time programming and experimenting with during the system start-up process. A simulator panel is currently included in the guide specifications, however, often the user is not allowed to "touch" the system until the contractor has completed the contract requirements.

Another aspect of user involvement that was clear from the follow on site visits is the lack of information sharing among sites with EMCS. Two of the sites visited had identical manufacturer's systems, one of which is 3 years old and the other of which has just been accepted by the Navy. Personnel at the new site were experiencing a number of difficulties and problems which had been solved previously by the other site, yet neither site was aware of the other's situation. Exchange of personnel between those sites or even just a few telephone calls could greatly improve the overall chance of success at the two sites. No mechanism for facilitating this information exchange is currently available.

3.2 CONTINUITY:

Lack of continuity in personnel throughout the course of an EMCS project continues to be a problem. The Navy construction process of design preparation by one organization, hand-off to another organization for construction, and hand-off to another organization for operation naturally provides opportunity for loss of concept and information. Probably even more important than loss of continuity from one phase to another (design to construction to operation) are continuity losses during any one portion of the project. This is particularly true during the construction process. Because EMCS projects have fairly long construction times, there can be a significant turn over of personnel both on the part of the Navy and on the part of the contractor. These changes often create problems in contract interpretation and smooth project implementation. Continuity is also a problem in terms of user involvement as discussed above. Often times the using agency personnel who had input to the design or early stages of construction may have changed by the time the system is ready to be turned over. The replacement personnel may have a different philosophy or approach than their predecessors. Even if that is not the case, their lack of knowledge of what has occurred previously on the project can make the system success more difficult.

3.3 USER ORGANIZATIONAL STRUCTURE:

The "fitting in" of an EMCS into a user's organization structure is still a very significant problem with Navy EMCS projects. Navy Public Works organizations vary widely in their structure and approach to satisfying their site's needs. Many of those structures are simply not set up to use the capabilities of an EMCS. An EMCS spans responsibilities of several different departments and if an EMCS is organizationally assigned within a specific department, its effectiveness in those other departments is diminished. No Navy wide guidelines or policies regarding this problem have been identified.

In addition to the difficulties in fitting in with the existing Public Works approach, additional problems may develop as the Navy evaluates "contracting out" Public Works functions. A number of sites are in the process of evaluating contracting with outside private firms to perform some of the Public Works functions. This process may significantly change Navy public works operations whether or not the work is actually contracted out. This change could affect EMCS success, not only at locations where the EMCS is planned or under construction, but could affect those locations where EMCS are being successfully operated now. The use of existing successful EMCS and their position within the organization should be accounted for in the "contracting out" process. If not, a valuable tool could be lost in the shuffle.

In general, the most successful organizational approach to EMCS found at the sites visited was to place the EMCS under direct responsibility of the Public Works energy conservation engineer. That engineer would have primary responsibility for EMCS implementation and day-to-day operation. He works on a cooperative basis with Maintenance Department and Utilities Department personnel in using EMCS. Personnel from those shops actually perform field trouble shooting and maintenance of EMCS, and use the alarm and run time reports from the EMCS in their day-to-day operation. The energy conservation engineer then is responsible for seeing that the EMCS is functioning properly and adjusting the operating parameters within the system to achieve maximum energy conservation. This approach, while successful at some installations, requires a great deal of cooperation on an informal basis among several groups within the Public Works organization. The key to this seems to be involvement on a day-to-day basis of section chiefs or shop foremen with their own responsibilities relative to the EMCS. In fact, this seems to be most effective when those individuals have their own terminals and can access and gain information from the EMCS that they need in their shop or department operations. This approach allows those individuals to gain benefit from the EMCS without having the responsibility for understanding all of the software or features of the system. They are essentially time-sharing users of the system for their own function and view the system as a tool for all groups to use on an equal basis instead of one particular department's empire.

As mentioned above in discussing user involvement, Command support is absolutely necessary for successful EMCS implementation. Without higher Command support for EMCS and for energy conservation, in general, the effectiveness of an EMCS cannot be realized. This is also true relative to EMCS integration into the user organizational structure. If no emphasize is placed on energy conservation then individuals within the structure will be less likely to work in the cooperative spirit needed for successful EMCS.

3.4 GUIDE SPECIFICATIONS:

Since the Kings Bay Study was prepared in 1981, the Army, Navy, and Air Force have undertaken a significant effort in updating and modifying the EMCS Guide Specifications. Many of the guide specifications comments identified in the Kings Bay Study have been addressed in the current (August, 1983) version of the NAVFAC EMCS Guide Specifications. In the course of the follow-up field investigation, some additional comments relative to guide specifications were noted. The following list is a consolidation of those new areas of concern and past comments from the Kings Bay Study which have not been incorporated in the guide specs:

A. The documentation requirements in the specification should be clarified and expanded. This is particularly true in the shop drawing and construction documentation area. The wide variety in approach and quality to system documentation from project to project points out the need for more definitive requirements in this area.

B. Major items of master control room equipment should be specified to be standard products of a single manufacturer. All computer memory, disk drives, tape drives, etc., should be provided by the manufacturer of the computer CPU. This approach assures the Owner of the ability to obtain a maintenance contract on the computer equipment in future years.

C. The complex CCU/CCC failover requirements should be reevaluated. With a distributed processing system many projects do not require back-up capability at the central site. If back-up capability is required, it is questionable whether the configuration called for in the specification is of real value. A better solution in that case would probably be to specify redundant computers to provide a fully functional system on failure of one of the computers.

D. The command and application software sections of the specifications are insufficiently defined. Considerable research and effort should be expended on these areas to assure effective system performance.

E. Distributed processing functions performed in the field interface device should be limited to basic application functions. Complex optimization algorithms should not be required to be performed at field level.

F. The requirement for color graphics operator interfaces should be reevaluated. System success appears to be related to the ability for a multitude of departments or users to access information within the EMCS. This is difficult to do if the only operator interface is through color graphics CRT terminals. The cost and data transmission speeds needed for those types of terminals make it difficult to provide them in the numbers and locations needed for effective system operation. While color graphic operator interface could remain in the guide specifications, more emphasis should be placed on operator interaction through conventional black and white CRTs which can more easily support the distributed use of the system as discussed above.

G. Specifications should call for all computer equipment to be current production models at the completion of the EMCS contract. Computer manufacturers are continually releasing new models and it is possible an EMCS contractor could supply equipment which is outdated or discontinued but which still meets the specification requirements.

3.5 NON-PROPRIETARY EXPANDABILITY:

One problem area that was identified in the Kings Bay Study was the difficulty of non-proprietary expansion of existing EMCS. Since that time, it has generally been recognized that the only practical way to expand or add to an existing EMCS is through some proprietary requirements. The nature of the proprietary requirements differs depending on the scope of the EMCS expansion. If the expansion project is very large relative to the existing EMCS, then it may require total replacement of the existing system or installation of a new system in parallel to the existing one. Interfaces between existing and new systems are generally difficult and may not be worth the effort. Sites which have successful EMCS installations have recognized the necessity to expand the system into additional buildings using equipment identical to that included in the existing systems.

This involves a proprietary specification of that field interface equipment for the addition of new buildings. While this has been of concern to those involved in expanding the EMCS, it has not been a significant problem at sites where it has been accomplished.

When a new building is to be added to the EMCS, the approach has been to include a proprietary specification as part of that new building's construction which includes installation of field interface panels and implementation of that new building on the central computer system. One of the major concerns with this approach in the past has been the possibility that the EMCS equipment supplier would have a "lock" on the new building conventional controls contract. This has not been the case in actual experience. In some cases, only the controls and sensors were specified as part of the new building construction and the field interface device was to be provided separately as part of another contract or by the Government. Many problems resulted from this approach due to the lack of definition of testing and ROICC enforcement during the building construction process.

Based on the experience at the sites visited, it is clear that the future expansion of an EMCS should be planned on a proprietary basis from the winner of the initial EMCS system supplier contract. The addition of a new building to the EMCS should be specified to be fully contained within that new building's construction contract. This, of course, assumes that the initial EMCS installation is operational and satisfactory to the user. This varies from site to site and the proprietary expansion approach must therefore be evaluated on a case-by-case basis.

3.6 MAINTENANCE STRATEGY:

In planning for an EMCS at their site, most user organizations plan on the EMCS vendor or manufacturer providing full maintenance service on a contract basis with little involvement on the part of the users. This strategy is usually due to the lack of familiarity on the part of the user with the EMCS system. It has not proven to be very effective in most instances.

The most effective approach to maintenance seems to be a combination of some sort of vendor maintenance contract with user day-to-day maintenance and trouble shooting responsibility. With this approach, the using agency personnel are responsible for diagnosing problems, card swapping, and preventive maintenance type functions. Once they identify a problem or a particular failed piece of equipment then that may be repaired by the original system vendor as part of a time and materials service contract. This approach makes the best use of the capabilities and availability of personnel from both the user and EMCS manufacturers viewpoints.

One difficulty that has been encountered with the use of local personnel to trouble shoot problems, is the lack of spare parts for use by the personnel. Most EMCS contracts have no provisions for a spare parts inventory to be turned over to the using agency because Military Construction funds are not authorized for operations and maintenance activity. If the using agency personnel diagnose problems by "card swapping", but do not have a supply of spare cards to replace those that are identified as malfunctional, they would be unable to maintain system operation while the malfunctioning cards are sent back to the manufacturer for repair. Some operations and maintenance funds should be planned specifically for purchase of a spare parts inventory. Ideally these should be coupled to the construction contract bid so maximum competition can provide the best parts inventory prices.

3.7 EXISTING FIELD CONDITIONS:

Since the Kings Bay Study, it has generally been recognized that more emphasis should be placed on documenting existing field and controls conditions. NAVFAC DM-4.9 (Design Manual for EMCS) places much more emphasis on this than was the case at the time of the Kings Bay Study. While this approach has reduced some of the construction problems encountered due to undocumented field conditions, it has opened up a new set of problems which may be of comparable magnitude. When the contractor arrives in the field to make his connections to the existing controls, he may find that the conditions at the time he arrives versus what is shown on the design drawings may differ. Often times, Base maintenance personnel modify field wiring and controls in the course of performing trouble shooting for equipment maintenance. If the time from performance of the design survey to the time at which the contractor makes the interface connection is very long, then the probability that some modification has occurred is greatly increased. This is particularly a danger when some of the more sophisticated procurement methods (two step or competitive negotiation) are used since these methods significantly add to the time period for procurement. It is possible many months or even years may have elapsed from the time of the design survey to the contractor installation time.

In addition to changes that may have been made by Base personnel, the same problems that the contractor has encountered in attempting to define control interfaces can be experienced by a design engineer. The field survey time during the design phase is significantly increased by attempting to document the existing controls condition and interfaces.

3.8 DESIGN COMMENTS:

In general, the comments made in the Kings Bay Study regarding EMCS design process had been incorporated into NAVFAC DM-4.9. One area that was not addressed in the Kings Bay Study but which became clear in the follow up site visits is the need for a mechanism to transfer lessons learned in actual EMCS construction back into the design process. Because of the structure of NAVFAC construction procedures, i.e., a Construction Division taking over from the Design Division during the construction process, many of the experiences and lessons learned during the construction of the EMCS are never reported to or incorporated into the design process for future systems. The designers or A/E's involved in the design process are not normally involved in the day-to-day construction of the EMCS and therefore do not gain the benefit of that experience. Some mechanism should be developed for quick dissemination of experience into the ongoing design process. It is clearly insufficient to rely on updates of the design manuals to accomplish this task. A design checklist should be compiled which could be updated on a continuing basis. It should be included in design contracts and used by the designers and reviewers. Standard details or formats for sensor installation, control interface diagrams, FID/MUX installation, etc. should be compiled based on experience during EMCS installation. Those should be disseminated as widely as possible. An example of the type information needed is a design checklist included as an Exhibit in Section 5.0.

3.9 CONTRACTOR QUALIFICATIONS:

The need for contractural mechanisms to discourage inexperienced and unqualified bidders on the EMCS projects is now widely recognized. A number of different approaches to this qualification process have been tried with varying degrees of success. One of the difficulties encountered is the need for two separate qualification processes. In the first case, the actual bidder or prime contractor on the EMCS project should be qualified as one who has installed similar systems on other projects. The second qualification needed is for the actual system that is proposed. While the prime bidder may have installed systems in the past, the system he proposes to use on the particular project may not be in operation at any location and may not be the one he has installed elsewhere. Because of this it is necessary that the system that is proposed be one which is successfully in operation in the field at the time of contract award.

While the need for contractor/system qualification is now recognized, there is very little guidance available on effective means of accomplishing this.

3.10 BIDDING AND CONSTRUCTION SCHEDULES:

In general, the need for longer bidding and construction schedules has been recognized and implemented on most EMCS projects.

3.11 SOFTWARE RIGHTS:

The need for definition of proprietary software restrictions has been recognized and is addressed in current guide specifications and design manuals. The approach called for is to use specific sections of the Defense Acquisition

Regulations (DAR) which define various "Rights in Technical Data". One difficulty with this approach has been the mechanism for defining which item of software or documentation falls within which category. A standard form (Form 1423) is generally used for that purpose, however, its use has been inconsistent and guidance available from higher headquarters on how to use the form has been minimal and sometimes confusing.

3.12 ROICC TECHNICAL ASSISTANCE:

The provision of EMCS technical assistance to the ROICC representatives varies widely from site to site. On some projects, complete A/E Title II services provide ROICC with a great deal of assistance. On other projects, no provisions are made to provide assistance or technical advice to the ROICC. Some more uniform procedure or guidance should be provided in order to insure the ROICC representatives have the technical resources needed to supervise the EMCS construction. In addition to EMCS technical assistance, it was noted at some sites that special technical support is needed in the HVAC controls area. As HVAC systems, and their controls, have become more sophisticated, it becomes less likely ROICC staffs will have the specialized experience needed to fully inspect and test those systems.

3.13 CONTRACT INTERPRETATION:

As was identified in the Kings Bay Study, varying interpretation of the same specification requirements has caused a great deal of difficulty for EMCS contractors. No mechanism exists within the Navy to provide for uniform interpretation of contract requirements or even for the exchange of information on interpretations between different project sites.

The Army has somewhat overcome this problem by identifying one division (Huntsville Division) as the center for EMCS technical information. By calling on Huntsville Division personnel, the Army construction representatives can generally provide more uniform contract interpretation than is available through the Navy mechanism.

3.14 SUBMITTALS:

As mentioned earlier in comments on guide specifications, a clear definition of requirements for shop drawings should be included in contracts. In addition, many problems have been encountered where submittals were made on a piece-meal and incomplete basis. This situation is generally covered by the contract General Provisions, however, those requirements have not been enforced properly in all cases.

One additional area not identified in the Kings Bay Study is the need to specify sufficient copies and make proper distribution to the user during the submittal review process. This is particularly important where a project is to add to an existing EMCS system and the using agency has a great deal of knowledge and experience with the existing system. In that situation, the user must have the opportunity to review the contractor's submittals prior to allowing him to proceed with construction.

Experience also has pointed out the need to require documentation submittal early enough in the construction project so that the appropriate personnel can evaluate the system testing (performance verification and endurance test) in the proper manner. If the contractor is allowed to deliver the completed documentation after those test are performed, then it is not possible for Government personnel to properly evaluate the performance of the test.

3.15 TESTING:

Experience at the sites visited points out the need for detailed point-by-point check out of the system in the field after installation. In general, the testing area of EMCS projects has greatly improved since the Kings Bay Report was written. New, more definitive, testing procedures have been developed and are now included in the FMCS Guide Specifications. Experience from the use of those detailed testing documents on the first few projects should be documented and disseminated so others may modify the procedures or gain from that experience.

3.16 PROGRESS PAYMENTS:

The need to control progress payments and relate them to actual system operation rather than simple hardware delivery has generally been recognized. The mechanism for accomplishing this varies widely on different projects and no definitive guidance has been provided. Approaches and use now vary from withholding a large percentage of the contract until completion to withholding a fixed dollar amount until contract completion. Guide specifications currently require that no hardware or software be delivered to the site until after successful completion of the factory acceptance test. This provision has proven useful in a number of instances, however, in at least one other case, the lack of enforcement of that provision has led to major difficulties later on in the project. If the contractor is allowed to deliver hardware and software to the site, he must be paid for that according to NAVFAC regulations unless some other contract provision prevents it. By allowing a contractor to deliver hardware and software to the site prior to successful completion of the factory test, much of the project may be paid for far in advance of system operation.

3.17 STAFFING:

The need for adequate staffing of EMCS with interested, qualified, and trained personnel is essential for successful system implementation. The approach discussed above under User Organizational Structure where the site energy conservation engineer is responsible for the system has been the most effective approach found on a Navy installation.

Difficulties have been encountered due to the lack of a standard for rating of EMCS personnel/technicians on a Navy-wide basis. This lack of standardized ratings makes it difficult for technicians to transfer into or out of EMCS operations, and thus makes it more difficult to attract qualified personnel.

3.18 DATA BASE FORMS:

EMCS guide specifications call for the contractor to furnish data base forms which will be filled out by the using agency. The intent of this process is to provide to the contractor the parameters necessary for EMCS start-up and operation. This information includes start and stop times for HVAC equipment controlled by the EMCS, alarm high and low limits, alarm messages, application programs control parameters, etc. Furnishing this information to the contractor should allow start-up of the EMCS in a fully functional and energy conserving mode. The guide specifications do not define what information will be furnished to the contractor, they simply call for the contractor to submit a set of forms which the Government is committed to fill out. This open ended commitment on the part of the Government has led to a great deal of difficulty on many projects. Often times the forms submitted by the contractor are extremely complex with minimal instructions. Much of the data requested on the forms that have been submitted is not known to the Government because the data is related to the design or configuration of the contractor's installation at the site. Sometimes it is not possible for the user to complete this information and thus much time and effort is wasted and the real purpose of the data base forms (gathering application program parameters) is not properly fulfilled.

3.19 TRAINING:

Past and current guide specifications contain requirements for computer programming training. Experience at all sites visited indicated that programming training was not useful. The complexity of the software and programming process requires much greater training than is possible within the time included in the specifications. Also, due to warranty restrictions, the actual programming modifications that might be made by the user can not be accomplished for at least one year after system acceptance. By this time any programming training that was received as part of the specification would have been forgotten.

On the other hand, one of the most useful features on successful EMCS is the algorithmic control sequence capability. The "programming" of the EMCS to perform control and energy conservation functions is really done using this algorithmic control sequence software. Time currently included in the specifications for computer programming training would be much better spent in more detailed algorithmic control sequence training and in general system operation training.

3.20 IMPLEMENTATION ASSISTANCE:

Some sites visited pointed out the need for technical assistance during the implementation process for their EMCS projects. This assistance primarily would involve advice on the energy conservation applications programs and their use with existing HVAC system. Early in an EMCS project a feasibility study is performed which identifies the energy conservation programs applicable for each HVAC system. However, when the EMCS is actually ready to be started-up two or three years later, the HVAC systems operation may have changed or the function of the area that they serve may have changed. Also the using agency personnel who are responsible for filling out the data base forms may not be familiar with the original concept or intent behind the energy conservation applications. In some cases, assistance is needed at this point and that should idealy be provided by the designer who did the initial feasibility study and EMCS point selection. Another approach would be to have a specialist on a NAVFAC or EFD basis provide this sort of assistance to the user.

3.21 FUTURE TRENDS:

Most of the large EMCS projects within NAVFAC have already been contracted for. Most future projects will be in the area of small EMCS for smaller installations or micro EMCS for single building control. In addition, a major trend is developing for the use of electronic direct digital controls (DDC) in lieu of the pneumatic control systems that have been in use for HVAC control for years. These trends must be anticipated and ground work done ahead of time in order to avoid some of the problems that have plagued the large EMCS implementation process. Guide specifications now available for micro and small EMCS were developed more as after thoughts to the large EMCS specification. Much more emphasis and effort should go into revising the micro and small EMCS specifications. Currently, many commercial production systems cannot meet the requirements of the micro or small EMCS specifications. In order to avoid some of the problems encountered with large EMCS, the guide specifications should be targeted toward purchase of commercial off-the-shelf type systems.

Currently, no guide specification is available for DDC systems. These systems will predominate in the future and have their own special set of problems. Unless solid application and specification guidance is developed at this time, many problems may result from DDC installations. One issue which must be addressed is the maintenance problems which will result from having a large variety of manufacturers of DDC equipment at any one site. Where with pneumatic systems several different manufacturers' equipment could be used to replace other manufacturers' equipment, this is not the case with direct digital control.

The need for contractor prequalification discussed earlier becomes an even more difficult problem with a micro or small EMCS installation. Those systems may range in cost from $20,000 to $200,000. Currently the most prevalent mechanisms for contractor qualification are the two-step procurement method or the competitive negotiation procurement methods. Each of those processes takes several months to complete and many many man-hours on the part of the Government for proposal review. Also, preparation of technical proposals by the EMCS bidders is expensive and time consuming. The cost for a bidder to prepare this information may be more than the potential profit and could prevent qualified bidders from submitting proposals. The cost on the Government side to review and process the proposals will be disproportionate to the size of the contract. Some mechanism must be developed to address these points. One approach would be to perform Tri-service wide acceptance test on a one time basis for a particular system and following that acceptance allow that bidder to submit on any future projects.

4.0 FOLLOW-UP INVESTIGATION RECOMMENDATIONS

The following items are recommended based on the site visit notes included in the Appendix (Volume II) and the findings indicated in Sections 2 and 3 of this report:

4.1 USER INVOLVEMENT:

User involvement in EMCS projects should be promoted by:

1. User involvement in EMCS installation checkout and start-up with contractor personnel.

2. Incorporation of user input into the design process.

3. User attendance at the factory test. Provide a special system overview session during the factory test specifically designed to explain the basic capabilities of the system to the user.

4. Specify a master control room simulator panel monitored and controlled by the EMCS such that the user can experiment with programming and EMCS operation without affecting systems in the field. Specify extensive use of the simulator panel during training sessions and allow user access during EMCS start-up and testing phases.

5. Promote information sharing among users at different EMCS sites. Tabulate a list of all EMCS systems on a Navy-wise basis with telephone numbers of user personnel at each site. Identify the particular EMCS manufacturers' equipment at each site. Provide copies to be posted in every EMCS master control room. Promote exchange of personnel from site to site to provide assistance during start-up phases of an EMCS.

4.2 CONTINUITY:

As much as possible, the same organization and personnel should be involved throughout the EMCS design, procurement, and construction process to provide continuity.

4.3 USER ORGANIZATIONAL STRUCTURE:

The following steps should be taken relative to EMCS implementation and the user organizational structure:

1. Prior to beginning the EMCS design process, a strategy should be developed for use of the EMCS and how it relates to the Public Works organization.

2. EMCS function and operation should be clearly defined in any "contracting out" process being evaluated for Base Public Works operations.

3. The most successful organizational approach found at EMCS sites places the energy conservation engineer in charge of the system with parallel responsibilities on the part of existing shop or department heads. This approach requires the use of a number of terminals throughout the organization to allow for access to the EMCS on a time-sharing system type basis.

4. Command support for an EMCS project must be obtained early in the project process and be reconfirmed on a regular basis. This is particularly true during the initial system start-up time when occupant resistance can limit the impact of the EMCS.

4.4 GUIDE SPECIFICATIONS:

Specific suggestions for guide specification changes are included in Section 3.4 of this report. It is recommended that these be implemented during the next guide specification revision process.

4.5 NON-PROPRIETARY EXPANDABILITY:

The following is recommended relative to EMCS expansion:

1. Where an EMCS project will only connect a portion of a facility and follow-on projects will connect the remaining part of the facility, plans should be made for other separate parallel systems for the expansion projects or inclusion of proprietary requirements in the expansion project. The most effective expansion approach has been to include proprietary specs for expansion equipment when the existing system is operational and acceptable.

2. When a new building is to be constructed on a Base having an existing EMCS, the addition of that building to the EMCS should be included in the construction contract. The contract should include proprietary specifications for field electronics to match the existing EMCS and should include the requirement to implement that building on the central EMCS computer.

3. A guide specification for accomplishing the one or two buildings EMCS expansion or addition on a proprietary basis should be developed. The project-by-project approach currently being used can lead to problems by not having proper testing or complete requirements included in the building construction contract.

4.6 MAINTENANCE STRATEGY:

The most effective approach to EMCS maintenance on a Navy facility is to train Navy personnel in field trouble-shooting and day-to-day maintenance task for the EMCS. A maintenance contract with the original EMCS supplier on a time and material basis would be used for repair of malfunctioning equipment or diagnosis of software bugs. Contracts should be modified to provide for a substantial quantity of spare parts to implement this strategy.

4.7 EXISTING FIELD CONDITIONS:

Existing controls interfaces should be documented on EMCS design drawings. Once those are prepared, they should be turned over to Base maintenance personnel who would be responsible for assuring that those interfaces are not changed before the EMCS contractor makes his connection or if they must be changed, that that is documented and turned over to the ROICC. This approach should minimize delays and change order cost impact of field controls changes and should make the Base maintenance personnel aware of the interfaces shown on the design drawings.

4.8 DESIGN COMMENTS:

NAVFAC should establish a mechanism to quickly and effectively document experiences from EMCS construction projects and disseminate that information to those designing new EMCS projects. The design checklist and an EMCS installation details notebook should be compiled to allow more uniform designs and to take advantage of lessons learned on past projects. Some central group should have the responsibility for maintaining and disseminating this information. This should be a cooperative effort on the part of all three DOD services.

4.9 CONTRACTOR QUALIFICATIONS:

Some mechanism should be used to assure EMCS contracts are only awarded to the contractors and for those systems which have a proven track record in EMCS installations. The contract must include contractor and system qualification requirements which can be evaluated prior to award. The two-step procurement method has been used successfully in this process. The competitive negotiation procurement method is also being used on a few projects. Some mechanism for providing guidance on the use of these methods should be prepared and disseminated. Experience gained from use of the two-step or competitive negotiation methods and sample specifications should be documented and distributed so as to avoid repeating the same problems on future projects.

4.10 BIDDING AND CONSTRUCTION SCHEDULES:

Bidding and construction schedules should be based on past EMCS project experience. This indicates longer schedules are needed than most conventional construction projects require.

4.11 SOFTWARE RIGHTS:

DAR clauses defining rights in technical data should be included in all EMCS contracts. More definitive guidance on the use of these paragraphs and the forms associated with those paragraphs should be prepared and disseminated by NAVFAC.

4.12 ROICC TECHNICAL ASSISTANCE:

Specialized technical assistance should be provided to ROICC offices during the EMCS construction process. Specialized assistance may also be required in inspection and testing of sophisticated conventional HVAC control systems. A specialist team on an EFD basis could be responsible for controls check-out of each major building project.

4.13 CONTRACT INTERPRETATION:

A central design review/contract interpretation group should be designated similar to the approach used on Army projects. This will provide for more uniform interpretation of guide specifications on different NAVFAC contracts.

4.14 SUBMITTALS:

The following is recommended regarding EMCS submittals:

1. Guide specifications should clearly define the requirements for shop drawings quality and scope. Requirements prohibiting submittals on a piece-meal and incomplete basis should be enforced.

2. Sufficient copies should be furnished such that users may participate in the submittal review process. This is particularly true where the project is an expansion of an existing system.

3. Completed documentation should be submitted early enough in a project to allow Government personnel to properly evaluate field, performance verification, and endurance tests.

4.15 TESTING:

Experience gained from early use of testing procedures developed by the Navy Civil Engineering Lab should be documented and disseminated to other users of the test procedures.

4.16 PROGRESS PAYMENTS:

EMCS contracts should include provisions to withhold substantial portions of the contract until after completion of the operational endurance test. Provisions preventing shipment of any computer or electronics equipment until factory test completion should be vigorously enforced.

4.17 STAFFING:

Adequate staffing of the EMCS with interested, qualified, and trained personnel is essential for successful implementation. The approach indicated under "User Organizational Structure" should be implemented. In addition, guidelines should be prepared by NAVFAC headquarters for rating of EMCS technical staff and their relationship to other technical positions within the Public Works organization. This will provide for mobility and flexibility in personnel assignments and will make it easier to attract qualified individuals to the EMCS staff.

4.18 DATA BASE FORMS:

EMCS guide specifications should be modified to limit the scope of data base information required to be furnished by the user. Standard forms listing the information required for various functions and applications could be developed from the specification requirements. Examples of these forms could be included in the contract to define to the contractor what information will be furnished him by the user. This would also enable the user to anticipate the effort that will be required of him in generating data base information.

4.19 TRAINING:

Computer programming training requirements should be eliminated from EMCS guide specifications. Those should be replaced with more extensive operator and algorithmic control sequence training sessions.

4.20 IMPLEMENTATION ASSISTANCE:

Arrangements should be made for the original EMCS designers or an energy conservation specialist to assist the user in completing data base forms and in EMCS start-up.

4.21 FUTURE TRENDS:

EMCS guide specifications for micro and small EMCS should be modified to be more compatible with commercial off-the-shelf systems. Substantial research and industry input is required for that process.

Guide specifications should be developed for direct digital control (DDC) systems. Application guidance for DDC systems should be prepared on a policy basis from NAVFAC headquarters. Guidance should be definitive to prevent problems with DDC that have been encountered with EMCS projects.

Guidance for the procurement process of micro and small EMCS projects should be developed. Micro and small EMC systems should be approved on a "product" basis by a Triservices review and testing committee. Only those products approved after extensive investigation and testing would be allowed to be bid on micro and small EMCS projects.

5.0 EXHIBITS:

Example Design Checklist.

EMCS PROJECT CHECKLIST	ISSUED: JUNE 1983	
PHASE: FINAL DESIGN	DATE	SHEET NO. 1 OF 14
PROJECT/LOCATION:	SECTION	REVIEWER

EMCS BID PACKAGE DRAWINGS

SUMMARY CHECK LIST ITEMS	P* [ ]	M/I* [ ]	N/A* [ ]	COMMENTS
TITLE SHEET	[ ]	[ ]	[ ]	
SITE DRAWING & WORK LOCATIONS	[ ]	[ ]	[ ]	
SYMBOLS & ABBREVIATION LIST	[ ]	[ ]	[ ]	
MCR CONSTRUCTION/ALTERATIONS	[ ]	[ ]	[ ]	
MCR POWER/HVAC/LIGHTING/ FIRE PROTECTION	[ ]	[ ]	[ ]	
MCR FURNISHINGS	[ ]	[ ]	[ ]	
MCR EMCS EQUIP. PHYSICAL LAYOUT	[ ]	[ ]	[ ]	
MCR O.A. INSTRUMENT SHELTER	[ ]	[ ]	[ ]	
MCR EQUIP. SPECIAL OPERATING CONDITIONS	[ ]	[ ]	[ ]	
EMCS BLOCK DIAGRAM W/FID/IMUX/MUX	[ ]	[ ]	[ ]	
DTM SYS. CONFIGURATION ** W/TELEPHONE EXCH.	[ ]	[ ]	[ ]	

COORDINATION:
**A/E TO PROVIDE LETTER FROM COMMUNICATIONS OFFICER VERIFYING DRAWING REQUIREMENTS.

*(P) Provided - (M/I) Missing/Incomplete - (N/A) Not Applicable

EMCS PROJECT CHECKLIST	ISSUED: JUNE 1983	
PHASE: FINAL DESIGN	DATE	SHEET NO. 2 OF 14
PROJECT/LOCATION:	SECTION	REVIEWER

EMCS BID PACKAGE DRAWINGS

SUMMARY CHECK LIST DRAWINGS	P* [ ]	M/I* [ ]	N/A* [ ]	COMMENTS
PORTIONS OF GOVERNMENT FURNISHED DTM **	[ ]	[ ]	[ ]	
LOCATION AND TYPE OF GOVERNMENT FURNISHED DATA TRANSMISSION EQUIPMENT **	[ ]	[ ]	[ ]	
PORTIONS OF CONTRACTOR FURNISHED DTM **	[ ]	[ ]	[ ]	
LOCATION AND TYPE OF CONTRACTOR FURNISHED DATA TRANSMISSION EQUIPMENT **	[ ]	[ ]	[ ]	
DTM EXTERIOR INST. DETAILS	[ ]	[ ]	[ ]	
DTM INTERIOR INST. DETAILS	[ ]	[ ]	[ ]	
INSTALLATION DETAILS SENSORS ***	[ ]	[ ]	[ ]	
INSTALLATION DETAILS CONTROLS ***	[ ]	[ ]	[ ]	
FID/MUX/IMUX INST. DETAILS	[ ]	[ ]	[ ]	
DTC INST. DETAILS	[ ]	[ ]	[ ]	
EQUIPMENT SYSTEM DIAGRAMS W/SENSORS AND CONTROLS FOR EVERY SYSTEM	[ ]	[ ]	[ ]	

COORDINATION:
**A/E TO PROVIDE LETTER FROM COMMUNICATIONS OFFICER VERIFYING DRAWING REQUIREMENTS.

*(P) Provided - (M/I) Missing/Incomplete - (N/A) Not Applicable
*** Required for Each Different Type

EMCS PROJECT CHECKLIST	ISSUED: JUNE 1983	
PHASE: FINAL DESIGN	DATE	SHEET NO. 3 OF 14
PROJECT/LOCATION:	SECTION	REVIEWER

EMCS BID PACKAGE DRAWINGS

SUMMARY CHECK LIST	P*	M/I*	N/A*	COMMENTS
DRAWINGS	[ ]	[ ]	[ ]	
GRAPHIC DISPLAY DIAGRAMS FOR EACH SYSTEM REQUIREMENT	[ ]	[ ]	[ ]	
EQUIPMENT SEQUENCE OF (xx) OPERATION FOR EACH SYSTEM	[ ]	[ ]	[ ]	
(xx) I/O SUMMARY TABLES W/FAILURE MODES FOR EACH SYSTEM	[ ]	[ ]	[ ]	
BUILDING & EQUIPMENT OPERATING SCHEDULES	[ ]	[ ]	[ ]	
SENSORS & CONTROLS OPERATING RANGES FOR EACH APPLICATION	[ ]	[ ]	[ ]	
TYPICAL STARTER INTERFACE DIAGRAMS WITH FAILURE MODES FOR EACH TYPE	[ ]	[ ]	[ ]	
TYPICAL CPA PNEUMATIC INTERFACE DIAGRAM W/FAILURE MODES FOR EACH TYPE	[ ]	[ ]	[ ]	
FLOOR PLANS/LAYOUT DWGS. FOR EACH WORK LOCATION:	[ ]	[ ]	[ ]	
NON EMCS MECH/ELEC EQUIP. LOCATIONS W/IDENT.	[ ]	[ ]	[ ]	
NON EMCS MECH/ELEC EQUIP. TO BE REPLACED/MODIFIED	[ ]	[ ]	[ ]	
REMOTE TERMINALS/PRINTER LOCATIONS	[ ]	[ ]	[ ]	

COORDINATION:

*(P) Provided - (M/I) Missing/Incomplete - (N/A) Not Applicable
(xx)- May be Provided in Specifications

EMCS PROJECT CHECKLIST	ISSUED: JUNE 1983	
PHASE: 95% DRAWINGS	DATE	SHEET NO. 4 OF 14
PROJECT/LOCATION:	SECTION	REVIEWER

EMCS BID PACKAGE DRAWINGS

SUMMARY CHECK LIST DRAWINGS	P* [ ]	M/I* [ ]	N/A* [ ]	COMMENTS
FID/MUX/IMUX LOCATION W/IDENTIFICATION	[ ]	[ ]	[ ]	
FID/MUX/IMUX POWER SOURCES	[ ]	[ ]	[ ]	
FID/MUX/IMUX W/COMPLETE BATTERY BACKUP	[ ]	[ ]	[ ]	
FID/MUX/IMUX W/SPECIAL OPERATING ENVIRONMENT CONDITIONS	[ ]	[ ]	[ ]	
DTC LOCATIONS	[ ]	[ ]	[ ]	
LOCATION EXIST. SENSORS/ CONTROLS TO BE INTERFACED	[ ]	[ ]	[ ]	
LOCATION & IDENT. OF SENSORS TO BE REPLACED/MODIFIED	[ ]	[ ]	[ ]	
LOCATION NEW SENSORS/CONTROLS W/POWER SOURCES	[ ]	[ ]	[ ]	
LOCATION & TYPE OF EXISTING STARTERS	[ ]	[ ]	[ ]	
LOCATION & TYPE OF NEW STARTERS	[ ]	[ ]	[ ]	
MECHANICAL/ELECTRICAL ROOM EQUIPMENT PLANS	[ ]	[ ]	[ ]	

COORDINATION:

*(P) Provided - (M/I) Missing/Incomplete - (N/A) Not Applicable

EMCS PROJECT CHECKLIST	ISSUED: JUNE 1983	
PHASE: FINAL DESIGN	DATE	SHEET NO. 5 OF 14
PROJECT/LOCATION:	SECTION	REVIEWER

EMCS BID PACKAGE DRAWINGS -

SUMMARY CHECK LIST	P*	M/I*	N/A*	COMMENTS
DRAWINGS	[ ]	[ ]	[ ]	
OTHER M/E WORK	[ ]	[ ]	[ ]	
	[ ]	[ ]	[ ]	
	[ ]	[ ]	[ ]	
	[ ]	[ ]	[ ]	
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COORDINATION:

*(P) Provided - (M/I) Missing/Incomplete - (N/A) Not Applicable

EMCS PROJECT CHECKLIST	ISSUED: JUNE 1983	
PHASE: FINAL DESIGN	DATE	SHEET NO. 6 OF 14
PROJECT/LOCATION:	SECTION	REVIEWER

100% COMPLETE EMCS SPECIFICATIONS

SUMMARY CHECK LIST EMCS SPECIFICATIONS:	P* [ ]	M/I* [ ]	N/A* [ ]	COMMENTS
SCOPE OF WORK	[ ]	[ ]	[ ]	
LIST BLDGS. IN PROJECT	[ ]	[ ]	[ ]	
MCR & FIELD EQUIP. ENVIR. CONDITION	[ ]	[ ]	[ ]	
OVERVOLTAGE & SURGE PROTECTION	[ ]	[ ]	[ ]	
TRAINING REQUIREMENTS	[ ]	[ ]	[ ]	
SHOP DRAWING REQUIREMENTS	[ ]	[ ]	[ ]	
FACTORY TEST REQUIREMENTS	[ ]	[ ]	[ ]	
SITE TEST REQUIREMENTS	[ ]	[ ]	[ ]	
O & M MANUAL REQUIREMENTS	[ ]	[ ]	[ ]	
CONSTRUCTION PERIOD EXISTING CONTROLS SURVEY & MAINTENANCE RESPONSIBILITY	[ ]	[ ]	[ ]	
GOV. FURNISHED DTM CHARACT.**	[ ]	[ ]	[ ]	

COORDINATION:
**A/E TO PROVIDE LETTER FROM COMMUNICATION OFFICER VERIFYING SPECIFICATION REQUIREMENTS.

*(P) Provided - (M/I) Missing/Incomplete - (N/A) Not Applicable

EMCS PROJECT CHECKLIST	ISSUED: JUNE 1983	
PHASE: FINAL DESIGN	DATE	SHEET NO. 7 OF 14
PROJECT/LOCATION:	SECTION	REVIEWER

100% COMPLETE EMCS SPECIFICATIONS

SUMMARY CHECK LIST EMCS SPECIFICATIONS (CONT.)	P* [ ]	M/I* [ ]	N/A* [ ]	COMMENTS
CONTRACTOR FURNISHED DTM ** CHARACTERISTICS	[ ]	[ ]	[ ]	
DTM TEST REQUIREMENTS	[ ]	[ ]	[ ]	
FID/MUX/IMUX PERCENT SPARE I/O FUNCTIONS	[ ]	[ ]	[ ]	
FID/MUX/IMUX COMPLETE BATTERY BACKUP	[ ]	[ ]	[ ]	
RAM/RTC BATTERY BACKUP	[ ]	[ ]	[ ]	
CCU/CCC MEMORY PROTECTION REQUIREMENTS	[ ]	[ ]	[ ]	
RTC BATTERY BACKUP REQUIREMENTS	[ ]	[ ]	[ ]	
MAX. POINT LOADING/DTM LINK	[ ]	[ ]	[ ]	CROSS CHECK AGAINST SYSTEM BLOCK DIAGRAM
GROUNDING REQUIREMENTS	[ ]	[ ]	[ ]	
APPLICATION PROGRAM EDITING	[ ]	[ ]	[ ]	CROSS CHECK WITH I/O SUMMARY FORMS
SPECIAL FID APPLICATION PROGRAMS	[ ]	[ ]	[ ]	CROSS CHECK WITH I/O SUMMARY FORMS

COORDINATION:
**A/E TO PROVIDE LETTER FROM COMMUNICATION OFFICER VERIFYING SPECIFICATION REQUIREMENTS.

*(P) Provided - (M/I) Missing/Incomplete - (N/A) Not Applicable

EMCS PROJECT CHECKLIST	ISSUED: JUNE 1983	
PHASE: FINAL DESIGN	DATE	SHEET NO. 8 OF 14
PROJECT/LOCATION:	SECTION	REVIEWER

100% COMPLETE EMCS SPECIFICATIONS

SUMMARY CHECK LIST EMCS SPECIFICATIONS (CONT.):	P* [ ]	M/I* [ ]	N/A* [ ]	COMMENTS
I/O SUMMARY TABLES W/FAILURE MODES (xx)	[ ]	[ ]	[ ]	
EQUIPMENT SEQUENCE OF OPERATION (xx)	[ ]	[ ]	[ ]	
BUILDING AND EQUIPMENT OPERATING SCHEDULES (xx)	[ ]	[ ]	[ ]	
(xx) SENSOR & CONTROL OPERATING RANGES FOR EACH APPLICATION	[ ]	[ ]	[ ]	
	[ ]	[ ]	[ ]	
	[ ]	[ ]	[ ]	
	[ ]	[ ]	[ ]	
	[ ]	[ ]	[ ]	
	[ ]	[ ]	[ ]	
	[ ]	[ ]	[ ]	
	[ ]	[ ]	[ ]	

COORDINATION:

*(P) Provided - (M/I) Missing/Incomplete - (N/A) Not Applicable
(xx) May be Provided on Drawings

EMCS PROJECT CHECKLIST	ISSUED: JUNE 1983	
PHASE: FINAL DESIGN	DATE	SHEET NO. 9 OF 14
PROJECT/LOCATION:	SECTION	REVIEWER

100% COMPLETE EMCS SPECIFICATIONS

SUMMARY CHECK LIST EMCS SPECIFICATION OPTIONS:	P* [ ]	M/I* [ ]	N/A* [ ]	COMMENTS
ENVIRONMENTAL CONDITIONS	[ ]	[ ]	[ ]	
SUBMITTAL SCHEDULES	[ ]	[ ]	[ ]	
REVIEW SCHEDULES	[ ]	[ ]	[ ]	
TESTING SCHEDULES	[ ]	[ ]	[ ]	
TRAINING SCHEDULES AND NUMBER OF PERSONNEL	[ ]	[ ]	[ ]	
GOVERNMENT FURNISHED DTM AVAILABILITY SCHEDULES	[ ]	[ ]	[ ]	
DTC REQUIREMENTS	[ ]	[ ]	[ ]	
SOLAR RADIATION & BAROMETRIC PRESSURE SENSORS	[ ]	[ ]	[ ]	
ADDITIONAL PERIPHERAL PORTS	[ ]	[ ]	[ ]	
COMMUNICATION LINK TERMINATION LOADING	[ ]	[ ]	[ ]	
DISK STORAGE CAPACITY	[ ]	[ ]	[ ]	

COORDINATION:

*(P) Provided - (M/I) Missing/Incomplete - (N/A) Not Applicable

EMCS PROJECT CHECKLIST	ISSUED: JUNE 1983	
PHASE: FINAL DESIGN	DATE	SHEET NO. 10 OF 14
PROJECT/LOCATION:	SECTION	REVIEWER

100% COMPLETE EMCS SPECIFICATIONS

SUMMARY CHECK LIST (CONTINUED) EMCS SPECIFICATION OPTIONS:	P* [ ]	M/I* [ ]	N/A* [ ]	COMMENTS
PRINTER SPEED	[ ]	[ ]	[ ]	
NUMBER OF COMMAND KEYS FOR OPERATOR'S CONSOLE	[ ]	[ ]	[ ]	
TELEPHONE MODEM HARDWARE AND SOFTWARE	[ ]	[ ]	[ ]	
REPORTS - NUMBER OF REPORTS PARAMETERS/ALARMS	[ ]	[ ]	[ ]	
ALARM MESSAGES - NUMBER OF MESSAGES	[ ]	[ ]	[ ]	
APPLICATION PROGRAMS - REQ'D COORDINATION WITH I/O FORMS	[ ]	[ ]	[ ]	
APPLICATION PROGRAM VARIABLES	[ ]	[ ]	[ ]	
FID RESIDENT PROGRAMS AND DATA STORAGE REQUIREMENTS	[ ]	[ ]	[ ]	
EXISTING CONTROLS REPORT SUBMISSION SCHEDULE	[ ]	[ ]	[ ]	
SIGNAL TRANSMISSION LOADING REQUIREMENTS	[ ]	[ ]	[ ]	
ENDURANCE TESTING PERCENT AVAILABILITY	[ ]	[ ]	[ ]	

COORDINATION:

*(P) Provided - (M/I) Missing/Incomplete - (N/A) Not Applicable

EMCS PROJECT CHECKLIST	ISSUED: JUNE 1983	
PHASE: FINAL DESIGN	DATE	SHEET NO. 11 OF 14
PROJECT/LOCATION:	SECTION	REVIEWER

100% COMPLETE EMCS SPECIFICATIONS

SUMMARY CHECK LIST (CONTINUED) EMCS SPECIFICATION OPTIONS:	P* [ ]	M/I* [ ]	N/A* [ ]	COMMENTS
MAINTENANCE & SERVICE INSPECTION SCHEDULES	[ ]	[ ]	[ ]	
MAINTENANCE & SERVICE EMERGENCY SERVICE REQUIREMTS	[ ]	[ ]	[ ]	
	[ ]	[ ]	[ ]	
	[ ]	[ ]	[ ]	
	[ ]	[ ]	[ ]	
	[ ]	[ ]	[ ]	
	[ ]	[ ]	[ ]	
	[ ]	[ ]	[ ]	
	[ ]	[ ]	[ ]	
	[ ]	[ ]	[ ]	
	[ ]	[ ]	[ ]	

COORDINATION:

*(P) Provided - (M/I) Missing/Incomplete - (N/A) Not Applicable

EMCS PROJECT CHECKLIST	ISSUED: JUNE 1983	
PHASE: FINAL DESIGN	DATE	SHEET NO. 12 OF 14
PROJECT/LOCATION:	SECTION	REVIEWER

100% COMPLETE EMCS SPECIFICATIONS

SUMMARY CHECK LIST	P*	M/I*	N/A*	COMMENTS
MECHANICAL SPECIFICATIONS	[ ]	[ ]	[ ]	
GENERAL REQUIREMENTS - MECH.	[ ]	[ ]	[ ]	
INSULATION OF MECH. SYSTEMS	[ ]	[ ]	[ ]	
UNITARY AIR CONDITIONING SYS.	[ ]	[ ]	[ ]	
AIR HANDLING & DISTRIBUTION EQUIPMENT	[ ]	[ ]	[ ]	
AIR SUPPLY SYSTEM	[ ]	[ ]	[ ]	
SPACE TEMPERATURE CONTROL SYS.	[ ]	[ ]	[ ]	
STEAM EQUIPMENT SYSTEMS	[ ]	[ ]	[ ]	
OTHER SPECIFICATIONS AS REQUIRED FOR PROJECT	[ ]	[ ]	[ ]	
	[ ]	[ ]	[ ]	
	[ ]	[ ]	[ ]	
	[ ]	[ ]	[ ]	

COORDINATION:

*(P) Provided - (M/I) Missing/Incomplete - (N/A) Not Applicable

EMCS PROJECT CHECKLIST	ISSUED: JUNE 1983	
PHASE: FINAL DESIGN	DATE	SHEET NO. 13 OF 14
PROJECT/LOCATION:	SECTION	REVIEWER

100% COMPLETE EMCS SPECIFICATIONS

SUMMARY CHECK LIST ELECTRICAL SPECIFICATIONS	P* [ ]	M/I* [ ]	N/A* [ ]	COMMENTS
GENERAL REQUIREMENTS - ELEC.	[ ]	[ ]	[ ]	
UNDERGROUND ELECTRICAL WORK	[ ]	[ ]	[ ]	VERIFY DTM AND POWER INST. REQUIREMENTS
OVERHEAD ELECTRICAL WORK	[ ]	[ ]	[ ]	VERIFY DTM AND POWER INST. REQUIREMENTS
INTERIOR WIRING SYSTEM	[ ]	[ ]	[ ]	POWER & LOW VOLTAGE WIRING EXPOSED/CONCEALED/CONDUIT STARTER AND CONTROL STATION
LIGHTING - INTERIOR	[ ]	[ ]	[ ]	TEMPEST REQUIREMENTS RF FILTERS
RADIO FREQUENCY FILTERS - POWER LINES	[ ]	[ ]	[ ]	
FIRE ALARM AND OTHER FIRE DETECTION SYSTEMS	[ ]	[ ]	[ ]	
INTERCOMMUNICATION SYSTEM	[ ]	[ ]	[ ]	DO NOT INCLUDE IN EMCS SPECIFICATION SECTION
OTHER SPECIFICATIONS AS REQUIRED FOR PROJECT	[ ]	[ ]	[ ]	
	[ ]	[ ]	[ ]	
	[ ]	[ ]	[ ]	

COORDINATION:

*(P) Provided - (M/I) Missing/Incomplete - (N/A) Not Applicable

EMCS PROJECT CHECKLIST	ISSUED: JUNE 1983	
PHASE: FINAL DESIGN	DATE	SHEET NO. 14 OF 14
PROJECT/LOCATION:	SECTION	REVIEWER

100% COMPLETE EMCS SPECIFICATIONS

SUMMARY CHECK LIST	P*	M/I*	N/A*	COMMENTS
EMCS CONTRACT SPECIAL PROVISIONS	[ ]	[ ]	[ ]	
DD 1423	[ ]	[ ]	[ ]	
APPLICABLE DARS	[ ]	[ ]	[ ]	
DESCRIPTIVE LITERATURE REQUIREMENTS (xx)	[ ]	[ ]	[ ]	
DATA LICENSE CLAUSE	[ ]	[ ]	[ ]	
PROPRIETARY DATA AGREEMENT CLAUSE	[ ]	[ ]	[ ]	
BIDDER QUALIFICATION STATEMENT	[ ]	[ ]	[ ]	
NEGOTIATED PROCUREMENT ** PROVISIONS	[ ]	[ ]	[ ]	
	[ ]	[ ]	[ ]	
	[ ]	[ ]	[ ]	
	[ ]	[ ]	[ ]	
	[ ]	[ ]	[ ]	

COORDINATION:

** To be used only with Negotiated Procurements
*(P) Provided - (M/I) Missing/Incomplete - (N/A) Not Applicable
(xx) To be used only with IFB and Descriptive Literature Requirements

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8