Chapter 7
Summary and Conclusions

D, CPO conducted an extensive investigation and analysis of how corrosion affects facilities and infrastructure within the Department of Defense. The study team found that DoD F&I management varies by respective military service and installation mission, specific environments, and available F&I personnel.

While management of F&I is fairly decentralized (each installation carries the management authority to support specific mission requirements), operations are governed by DoD, the military services, and regional and local policies and guidance. The local management and execution of sustainment, restoration, and modernization, however, is the responsibility of each public works officer, department of public works, or base civil engineer.

Facilities professionals who are responsible for the management and oversight of DoD facilities and infrastructure, including the DUSD(I&E), each military service, the services’ subordinate commands, and a multitude of supporting elements, were involved in responding to this study.

The response to NDAA requirements and objectives language are located in the following chapters:

- Chapter 1 presented the sampling technique of the FICE study team. Sampled facilities were representative by facility type, military department, and facility age.
- Chapter 3 presented the key drivers of corrosion-related costs.
- Chapter 4 presented the study team’s assessment of a planned facility construction programs.
- Chapter 5 identified corrosion prevention and mitigation technologies that may be integrated into future facilities.
- Chapter 6 outlined, at a high level, service-specific facility engineering processes as they relate to corrosion prevention and mitigation.

The underlying challenges that each military service faces in the sustainment of F&I are fairly similar. Installations must address CPC adequately within the constraints under which they operate, but opportunities for improvement exist.
MAJOR FINDINGS

Defining Corrosion

Four key dimensions provided context for the FICE study:

- Planning and programming
- Acquisition (design and construction)
- Sustainment (operations and maintenance)
- Technology identification and implementation.

In each of these dimensions, F&I personnel are faced with corrosion-related decisions that affect material performance and system service life. Thus, factors that influence the corrosion-related decision process are adequate knowledge of corrosion policies and criteria and beneficial technologies, awareness of best practices, and advocacy for implementation.

It is important to note that most F&I personnel are facilities-centric or focused on a specific trade, engineering discipline, or management process; they are not necessarily focused on corrosion. In the course of their duties, they experience corrosion that affects the longevity or performance of facility components. They may accept corrosion as normal wear, not knowing that corrosion prevention criteria or mitigation technologies are available. Of course, personnel at installations in high ESI zones are more proactive in preventing corrosion because the high corrosivity and immediate effect of corrosion damage require a more conscientious and lasting course of action.

F&I-specific corrosion prevention and mitigation measures are in place within relevant focus areas, including policies, design and construction criteria, technology, MILCON, and SRM programs. Despite the extensive corrosion-related language in regulations, instructions, policies, and guidance, the FICE study team noted instances when field-level implementation of those policies and guidance was not well executed. The study team also observed that the lack of focus on corrosion issues was related in part to the perception that corrosion was viewed only as rust and the oxidation of metals, rather than the more comprehensive definition outlined in congressional language. That lack of awareness did not diminish the focus of the F&I community on the compelling need to address material degradation. Increasing the community’s knowledge of the fundamentals of corrosion prevention and availability of CPC technologies would improve decision making at all stages of facility management.

This finding highlights the need for further expansion of communications and outreach by the corrosion community to better educate the F&I community.
Communications

Each military department has clear and direct channels of communication for their respective installations. This establishes a chain of command in which CPC guidance and policies are issued from higher headquarters. Individual installations provide feedback to headquarters regarding the implementation and effectiveness of this guidance.

The study team found CPC communications was limited between installations either within a service or across services. This limits the sharing of valuable and useful information on CPC-related technologies, best practices, methods, and processes. A few F&I professionals reach out to similar installations with similar mission objectives; more often, installations consider themselves unique, with challenges that differ—in both mission and objectives—from other sites.

From a CPC perspective there is significant commonality across sites. Discussions with participating F&I personnel suggested a centralized forum for discussion of challenges, lessons learned, best practices, and policy would be beneficial, not only to address these topics, but also to foster collaboration.

Training

The study team found that CPC training is minimal because of funding constraints and the lack of available coursework with direct application to the areas of responsibility. Further projecting the need for more CPC training is the high personnel turnover (the result of an aging workforce) with limited knowledge transfer results in lost corrosion-specific expertise. Younger and newer personnel have minimal corrosion-related experience or are not aware of corrosion prevention choices.

Because funding is limited for training and education of personnel at all levels, higher priority training requirements compete for or displace the training resources required for corrosion training.

Training and education provides the knowledge base to make better corrosion-related decisions and promote corrosion prevention advocacy. Several installations indicated that effective corrosion training and education needed to be low cost, a reasonable time length, and have direct application to their area of responsibility.

Joint Bases

The F&I maintenance processes for joint bases, including CPC, are well established and working; however, installations continue to adjust and transition because residual contracts and contract support are in place before the transition to a joint bases. The differences in acquisition processes between the tenant organizations and the host military services also factor into the challenges of CPC management.
The policies that are followed reflect the primary military service that is facilitating the installation, but there are instances when two sets of guidelines are followed. Another FICE study team observation involved the confusion over which criteria to follow (tenant or host), particularly in regards to direct mission facility needs.

What is clear is the necessity for the deliberate participation of all stakeholders toward meeting the objectives- and mission-related facility requirements. Organizational priorities are addressed as a joint team, and then executed based on resources and priority. The beneficial results from joint basing with respect to CPC will not be immediately realized as the transition is still ongoing.

**Installation Realignment**

Base realignment has resulted in the addition of new tenants on existing installations. In some cases, the host installations have not been given additional resources to support the increased sustainment requirements. This will limit CPC efforts because F&I staff shift from a proactive management of materials degradation and reactively address the most immediate health and safety concerns. Deferred maintenance of facilities and infrastructure will inevitably reach a threshold where material degradation will become so bad that total recapitalization is necessary.

**Competing Priorities**

Some installation responses spoke unfavorably about the need to become Leadership in Energy and Environmental Design (LEED) certified because the cost to obtain and maintain the certification strains the ability to shift resources to meet other priorities. The resources spent for certification are not available for CPC efforts and tradeoff decisions needs to be made. ATFP, the National Historic Preservation Act of 1966, and environmental program requirements similarly reduce available funding otherwise slated for high-priority SRM deficiency (including corrosion degradation) correction.

**Policy**

CPC is addressed extensively in various policies and criteria. Some policies and guidance are not being followed or are not being well executed at some installations. Awareness is less than optimal at the installation and design agent level, and few personnel fully understand the *Whole Building Design Guide* and the significant CPC-related criteria (UFCs and UFGSs) contained within it.

There must be a balance between standardization of policies across DoD and the flexibility in the application of those policies with respect to each installation’s challenges and requirements. In some instances, standard policies have negatively affected CPC; other locations rely on the knowledge of general commercial practice and are unaware of DoD or military service CPC guidance. Increasing policy
Awareness can be accomplished through the chain of command and as part of training modules.

**Acquisition**

The best-performing contracting groups, from a CPC perspective, are staffed as part of the F&I organization; thus ensuring contracting personnel are knowledgeable regarding facilities construction and maintenance as well as corrosion. Achieving desirable CPC outcomes is more of a challenge at installations where contracting personnel are unfamiliar with facilities or installations.

Inconsistencies in the use of the WBDG criteria for design and construction can result in a deficiency to contract for DoD-mandated levels of standardization and quality. This is a potential cost problem that includes questionable identification of and contracting for CPC requirements.

Some installations indicated that mandatory contracting targets, such as contract laws and mandated small business set-aside programs (8[a], HUBZone, SDVOSB, etc.), hinder their ability to obtain the best-qualified CPC contractor and solution. Installations prefer a centrally managed, multiple-use or multi-purpose contracting vehicle for expediency of project execution.

For design-build projects, the contractor has greater flexibility in using newer, better technologies to meet the performance requirements of the contract. In many cases, however, the contractors shy away from offering CPC technologies that would exceed the minimum performance requirements—even if the technologies would provide a lifecycle cost advantage—because these technologies cost more initially and increase project costs, putting the contractor at a competitive disadvantage. Technical selection factors in the source selection process typically do not include specific CPC considerations.

Where CPC is not addressed in the design phase, it is difficult to correct in the contracting phase (normally increases costs). Possible improvements include educating design agents on CPC and lifecycle criteria, along with improving construction management awareness of CPC.

**Technology**

The transition of F&I technology remains a challenge, given the lack of resources and the need to ensure only the most mature and reliable technologies are employed. Among the challenges integrating new technologies are initial-cost versus long-term costs, proven reliability, low maintenance, and acceptance and familiarization by the facilities community.

Field personnel are also either not aware of new developments and technologies or neglect to apply the new criteria that would reduce the effect of corrosion on facilities. Technology development and implementation is highly reliant on...
commercial practice and is not always focused on unique DoD needs. Similarly, UFCs do not always address the best CPC practice in unique environments, potentially shortening the effective lifecycle of a facility. The WBDG also significantly lags in the adoption of criteria for new technology, delaying the benefits many facilities may glean.

The collaborative efforts of DoD, the military services, industry, and the academic community continue to be an essential “force multiplier” to ensuring the latest technologies are assessed and transitioned into an appropriate format for use by F&I professionals. Most personnel interviewed by the FICE study team were more comfortable with a higher headquarters requiring and directing the implementation of new technologies, rather than having a choice of implementation. Possible improvements include continued work on transitioning of new technologies into criteria, review of technologies and directed use where economically beneficial, and review of current technologies for cost and ROI advantages.

**MILCON and SRM**

An assessment of a planned facility construction program was requested, and the D, CPO selected P-65271 Hospital Replacement, Naval Hospital Guam. Guam is one of the most severe environments, so it was appropriate to explore the culmination of CPC considerations (policies, technology, cost drivers) in the planning of the program. The assessment results show that appropriate CPC planning and decisions made in the development of this project will directly enhance the facilities’ lifecycle and is a good model of a military construction project from a CPC perspective.

Of concern for all SRM and MILCON is quality assurance (government) and quality control (contractor) to ensure construction is consistent with the contract documents, and includes CPC aspects of project execution. Lack of CPC-trained personnel and available resources directly affect the quality of completed construction. The study team found that providing greater CPC awareness for BOS contractors providing SRM support at DoD installations would extend the facilities’ service life. The team also observed how the adherence to criteria in the UFGS and correct UFGS application usually results in CPC being included on projects.

While design agents and design teams are knowledgeable of the UFGSs and UFCs, they may be marginally aware of CPC requirements and the benefits of material selection. Improving design agent CPC awareness will increase the knowledge base and improve corrosion-related decision making.
Management Systems

Maintenance management systems in use by the military services lack the coding necessary to identify corrosion-related requirements. Having this information would assist in resourcing decisions, maintenance prioritization, identification of technology gaps, and maintenance backlog categorization.

Service maintenance management information systems are of varying complexity and usefulness, although none of them address military service–wide SRM management needs. Despite the use of condition assessment programs and maintenance management systems over the years, the military services have recognized the difficulties in accurately and consistently measuring and reporting the condition and backlog of SRM needs against their facilities.

Specifically, GFEBS uses Systems Applications and Products in Data Processing (SAP) software, a commercial off-the-shelf (COTS) enterprise resource planning (ERP) solution. Because of the initial intent of the system’s financial design, the overall system lacks many of the easy-to-use tracking mechanisms that are needed by the DPW to monitor, track, and prioritize day-to-day SRM projects. Many installations have created their own Excel-based spreadsheets to more easily manage their SRM workload. The older tracking systems used by the installations had been adapted to provide the needed monitoring/tracking information. The new system does not provide the easy access to determine trends in problems, which could be helpful for the DPW.

In the past, each military service employed separate processes of varying scope and complexity to manage SRM needs. Lack of resources, especially the loss of the journeyman experts who periodically looked at every structure and facility, has made this key information unavailable to facilities managers and higher headquarters. As a result, resourcing decisions and F&I service life are impaired.

A missing element in workflow management systems is a CPC metric to determine if maintenance actions are adequately addressing corrosion degradation. Most maintenance actions and requirements are not corrosion-centric, but corrosion can be a root cause or a contributing factor in the need for action. Other maintenance can be preventive in nature and not corrective. Because of the complexity of the maintenance requirement, information technology–based workflow systems cannot distinguish between CPC and non-CPC work.

Another challenge is backlog or requirements that are not funded and, therefore, deferred. The effect of deferred maintenance is increased degradation and greater costs, because more action may be required to correct the additional damage. Backlog adds to funding requirements that may not have been anticipated in the prior year planning and budgeting. This creates a scenario in which maintenance requirements quickly outgrow available funding, and it feeds a continuous cycle of increasing deferred maintenance levels.
Installations have learned to prioritize and couple the “worst first” with a scaled importance to the military mission; but the backlog is never cleared. CPC plays a part in optimizing facility service life and component performance. Thus, applying consistent CPC processes provides long-term benefits that initially may not be realized.

**CONCLUSION**

The continued corrosion degradation of F&I, factored with a high operating tempo and constraints on resources, will negatively affect the F&I community’s ability to provide mission-ready support capabilities for DoD. The military services are addressing CPC within their particular operational constraints. Areas of immediate concern that need improvement include training, communications, contracting, contract execution, new technology implementation, and data collection and management.

*While not specific topics of this study, it should be noted that both Base Closure and Realignment and sequestration will have a bearing on corrosion impacts for DoD Facilities and Infrastructure. Closure of aging facilities will reduce associated corrosion-related sustainment costs. Sequestration will result in increasing levels of deferred maintenance and consequently result in higher levels of corrosion damage which will have negative impacts on cost and mission readiness.*