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PURPOSE

The Design Engineering Desk Guide, later referred to as the Desk Guide provides reference information, lessons learned, and Standard Operating Procedures for Engineers to use in processing Design Projects from conception of the design to the completion of the project and final closeout.

SCOPE AND APPLICABILITY

This Desk Guide applies to all design efforts released from the Design Engineering group within Engineering Services. It is intended to provide an in-depth overview of the processes utilizing embedded links to the specific documents that provide the more detailed, specific information for each area using DMSOs (Division Management Standing Orders). The Desk Guide covers the entire process from submittal of a work request through product release into the KSC Engineering Documentation System (KEDS), or for projects of minimal scope, through attachment to the Maximo work order. The goal is to provide a quality product, on time, within the contract scope of work, and within the assigned man-hours.

PROCESS

This Desk Guide details the methods, requirements. and processes to be used in implementing any design project for Base Operations and Spaceport Services (BOSS) Engineering Services. Design Engineering is a discipline that creates and transforms ideas and concepts into a product definition that satisfies customer requirements. The role of the Design Engineer (DE) is the creation, synthesis, iteration, and presentation of design solutions. The Design Engineer coordinates with engineering specialists and integrates their inputs to produce the form, fit, and function documentation to completely define the product. The practice of engineering design is the process of devising a system, component, or process to meet desired needs. It is a decision-making process (often iterative), in which the basic science and mathematics and engineering sciences are applied to convert resources optimally to meet a stated objective. Among the fundamental elements of the design process are the establishment of objectives and criteria, synthesis, analysis, construction, testing, and evaluation.

1. DESIGN CONSIDERATIONS

1.1. General

The following sections need to be reviewed for every Engineering Product developed to ensure the highest quality product for our customer. When required by a Design Engineering Manager, complete Engineering Design Checklist form ENG-F-DE46 for the project’s design efforts. Validate all applicable milestone actions as complete to confirm achievement of that specific milestone. If the form is not required to be completed for a project, all assigned Design Engineers must review the checklist to help ensure that all project components have been addressed.

1.2. Quality, Safety, and Environmental

1.2.1. KSC Form 21-608, KSC Environmental Checklist (and AF Form 813 (Environmental Checklist) for projects located on CCSFS).

1.2.1.1. A KSC Environmental Checklist is required to be submitted for BOSS implemented construction projects and activities. As part of procedure EAP-P-4000, National Environmental Policy Act (NEPA) Review Process, BOSS Quality, Safety, and Environmental (QSE) uses KSC Environmental Checklists to identify environmental issues and the need for environmental regulatory permist in developing environmental requirements for projects and activities. The Lead Design Engineer (LDE) requests QSE to prepare a KSC Environmental Checklist and provides detailed information necessary to prepare one at the earliest stage of the design possible to make sure that all environmental issues are identified. QSE processes the KSC Checklist and provides the LDE an internal QSE response or a NASA Record of Environmental Consideration (REC) response to the checklist listing environmental requirements for the project or activity. QSE will coordinate any required responses to NASA Environmental called out on the REC. For projects at CCSFS or PSFB, an AF response may also be provided. The REC is valid for six (6) months. The LDE or PM requests QSE to obtain an updated checklist review and response if the project scope changes or if the project has not started within six (6) months of the date the checklist/REC response was issued.

1.2.1.2. Include in the design package requirements provided by QSE to Design Engineering during the design phase. Include this input no later than the 90% review package. Adequately address QSE's input in the 100% design as they are a signatory on design drawing releases.

1.2.1.3. If applicable, the LDE will coordinate with the assigned project QSE Environmental Representative to obtain suggested EPA affirmative procurement items to be used in the project.

1.2.1.4. For BOSS contracted projects, QSE provides Design Engineering input using form EAP-F-4800A (BOSS CONTRACTOR DETAILED ENVIRONMENTAL REQUIREMENTS). This form documents the project specific environmental requirements and submittals by the Contractor which are required in the design no later than the 90% review package. For projects with limited environmental impacts, QSE may provide input using form EAP-F-4800C (BOSS CONTRACTOR GENERAL ENVIRONMENTAL REQUIREMENTS).

1.2.1.5. For BOSS contracted projects, EA provides Design Engineering input using form EAP-F-4800A, BOSS CONTRACTOR DETAILED ENVIRONMENTAL REQUIREMENTS. This form documents the project specific environmental requirements and submittals by the Contractor which are required in the design no later than the 90% review package.

1.2.1.6. For BOSS contracted projects, QSE provides Design Engineering with safety input based on SHP-F-1926A, BOSS CONTRACTOR DETAILED SAFETY REQUIREMENTS, and/or SHP-F-1926B, CONTRACTOR GENERAL SAFETY

REQUIREMENTS. These documets provide the project specific safety requirements which are required in the design no later than the 90% review package.

1.2.1.7. For BOSS contracted projects, QSE provides Design Engineering with system safety input base on SMA-P-0015, RISK MANAGEMENT PLAN. This document provides the project specific system safety requirements which are required in the design no later than the 90% review package.

1.3. Hazardous Material Sampling/Testing

1.3.1. Assess/determine the need for any hazardous material sampling/testing at the Project Scope Agreement (PSA) meeting.

1.3.2. The Project Manager (PM) checks for the presence of hazardus materials and coordinates with the assigned QSE representative(s) on the project team to determine what types of sampling and testing may be required.

1.3.3. To check for presence of Asbestos Containing Material (ACM):

1.3.3.1. Research for existing data by accessing the Asbestos & Material Information System (AMIS) at: http://amis.ksc.nasa.gov/.

1.3.3.2. Review the List of Suspect Asbestos Containing Materials appendix in KNPR 1840.19, Kennedy Space Center Industrial Hygiene Programs.

1.3.3.3. If all suspect ACM that will be disturbed or may become disturbed as part of the scope of the design are listed in AMIS and are negative for asbestos, then there are no asbestos hazards.

1.3.3.4. If suspect ACM is present and not identified in AMIS, the PM can presume the material(s) contain asbestos or must contact QSE and request bulk sampling of the material(s) or written guidance.

1.3.4. To check for presence of PCBs or Hazardous Metals:

1.3.4.1. Research for existing data by accessing AMIS.

1.3.4.2. If all suspect material(s) that will be disturbed or may become disturbed as part of the scope of the design are listed in AMIS and are negative for PCBs and Hazardous Metals, then there are no PCB or Hazardous Metals hazards.

1.3.4.3. If suspect material(s) are present and not identified in AMIS, then contact QSE and request bulk sampling of the material(s) or written guidance.

1.3.5. BOSS QSE

1.3.5.1. Will coordinate sampling with the KSC Environmental Contractor and determine whether the sampled material produces a hazardous or controlled waste. QSE will provide the analysis report to the PM. The NASA Environmental Contractor or external lab support requires a minimum of three (3) weeks to schedule work, perform sampling, complete the analysis, and submit reports.

1.4. Environmental Permit

1.4.1. An application for a regulatory permit is required when the planned project exceeds the permitting determination thresholds for one (1) or more of the following categories: Air Emissions, Consumptive Use of Water including Dewatering, Dewatering Operations, Domestic Wastewater, Dredge and Fill, Industrial Wastewater, Potable Water, Solid Waste, or Stormwater Management.

1.4.2. For a typical subcontracted facility project, DE procures the Environmental permit application preparation services, either as a stand alone contract or part of the project SOW QSE supports DE as required to provide administrative and technical information needed for the application, reviews the draft application materials for accuracy and completeness, and works with the PM or assigned Engineer or Contractor Engineer to get the application finalized. QSE forwards the final application to NASA for signature, and submittal to the permitting agency. The applicaton fee must be included in project costs as NASA no longer provides it. Any requests for additional information (RAI) from the regulatory agency regarding the permit application package will be forwarded by QSE to the assigned Engineer for preparation of responses. Submit RAI responses to the NASA EAB through QSE for submission to the regulatory agency. After the permit is issued, QSE distributes the received permit application back to Design Engineering and/or the operational organization using it.

1.4.3. Upon receipt of regulatory permits, QSE distributes the permits and will conduct meetings with the stakeholders as necessary to review permit requirements and to clearly define and document organizational roles and responsibilities for complying with the requirements.

1.4.4. Original Environmental Permits are kept by NASA Environmental. opies of the permit are kept in the QSE office and a copy of the permit given to Engineering or any other BOSS department upon request.

1.5. Storm Water Pollution Prevention Plan (SWPPP)

Prepare and implement a SWPPP as part of a Florida Department of Environmental Protection (FDEP) National Pollutant Discharge Elimination System (NPDES) general stormwater construction permit if one (1) acre (43,560 sq. ft) or more is to be disturbed. Submit a Notice of Intent (NOI) with attached SWPPP to use the general permit to FDEP through EA and NASA and at the completion of the project a Notice of Termination (NOT). It is the Construction Contractor's responsibility (through the submittal process) to provide the NOI and NOT. QSE identifies the requirement for NOI and NOT and request the Lead Design Engineer (LDE) add them to the submittal register of the project specification package as part of compliance with form EAP-F-4800A, BOSS CONTRACTOR DETAILED ENVIRONMENTAL REQUIREMENTS provided for the design.

1.6. Excavation and Dig Permits

These permits are normally prepared and submitted by Construction Services (CS) or others outside of Design Engineering in accordance with ENG-I-MP07, Utility Locate/Excavation Permits. Any modification to an existing grade or area storm drainage

profile by digging, cutting an existing grade, probing, drilling, installing tie down rods, driving grounding rods, trenching and back filling, and all other penetrations to subsurface area require a dig permit. On all major modifications and construction projects the requester/subcontractor provides an as-built drawing of installed underground utilities for approval in order to close out the excavation permit. Note that, if needed, this also initiates a wildlife assessment survey by Environmental.

1.7. Outages

The outage request is normally prepared and submitted by Construction Services or others outside Design Engineering in accordance with MSO-P-0002, Outage Coordination Procedure.

1.8. Survey/Underground Locate

1.8.1. Coordinate all improvements to the exterior footprint of a facility, or any surrounding utilities with BOSS Site Services Master Planning. This direction helps to ensure all future “Site” improvements, no matter how small, are designed in accordance with KSC Site Planing policies.

1.8.2. Request for a Design Locate/Survey – Make sure your design basis of estimate (BOE) includes hours for survey support, when design phase surveys are required. Coordiante with the BOSS Survey Supervisor to requiest support. Provide sufficient detail in order for the Survey group to understand the project and for them to schedule the survey in accordance with ENG-I-0013, Surveying and Underground Locators Processes.

1.8.3. Request for a Utility Locate – Utility locates in support of anything other than excavation (meaning design, site plans, fact finding, etc.) will not require an excavation permit. While Excavation Permits (Dig Permits) do include utility locating, this task is limited to the extent of protecting personal safety and KSC infrastructure and *shall not* be used for design locate work.

1.8.4. Develop the Project Site Plan from existing or newly acquired survey data and meet the following requirements:

1.8.4.1. Horizontal accuracy: Reference all site plans, surveys/drawings to Florida State Plane Coordinate System, East Zone, North American Datum 1983 (/1990) adjustment based on Second Order Class II horizontal control monument.

1.8.4.2. Vertical accuracy: Reference all site plans, surveys/drawings to North American Vertical Datum (NAVD) 1988. Include a description of the reference benchmarks from which the NAVD has been determined, include topographical information within survey.

1.8.4.3. Location of all lines, conduits, valves, fittings, fire hydrants, meters, terminal points using at least two (2) ties to permanent points (manholes, power poles, curbs, or storm water inlets), or Global Positioning Satellite (GPS) coordinates with survey grade accuracy. An acceptable station and offset system may be used for service lines and fitting only. Utility locations are typically required and coordinated in conjunction with survey tasking.

1.8.4.4. Pertinent easement information.

1.8.4.5. All surveys created by BOSS surveying and/or outside consultants are based on the National Spatial Reference System and is a 3D file. When this electronic file is provided to BOSS DE personnel, be sure that it is not scaled, relocated, converted to 2D, etc. Engineers and drafters can add existing and new information to the file using BOSS Design ENG-H-0001, ENG-H-0001a and ENG-H-0001b for symbols and layering.

1.8.4.6. Review, verify, and coordinate all information gathered by BOSS Surveying and/or BOSS Design Engineering with the information available from BOSS GIS. If conflicts are found between the survey and GIS then field verification and utility location verification is required. Do not proceed forward on any project until all conflicts have been addressed and resolved.

1.8.4.7. Guideline for Exterior Improvements or Surrounding Utilities: Both BOSS Survey and GIS are based upon the National Spatial Reference System. Base Sheets can have new improvements referenced to them with all proposed improvements also based on the National Spatial Reference System. If a Design project contains improvement to the exterior of a facility that extends beyond the existing facility footprint, a Civil Engineer needs to be assigned to develop a common base site plan to use for designing purposes. Document all above ground features modified and/or underground utility modifications on the drawings. These requirements are applicable for all utility systems.

1.9. KSC Site Plan

1.9.1. An approved Site Plan is required on projects that make changes to facility footprints, installation of new facilities, sheds, slabs, or other structures, utilities, explosives, or instruments potentially impacting Radio Frequency (RF) sensitive equipment located on NASA property. The approved site plan is required prior to the start of design and provides the means of locating a proposed land-use or facility. Its purpose is to provide a document and procedure for coordination and approval by the pertinent NASA Offices in order to identify potential constraints and their respective resolutions in a consistent and comprehensive manner. The process provides a routine by which management can measure an individual project’s consistency with long range planning and budgeting efforts, maximize efficient use of existing resources, reduce the potential for costly redesigns and otherwise provide the opportunity for an informed decision to be made by the approving authority. Excavation permit approval includes a check for Siting approval, coordination on environmental issues, and the ability to update maps when the project is completed.

1.9.2. For further information on processing Site Requests refer to ENG-I-MP01, Site Plan Work Instructions.

1.10. Sustainable Engineering

1.10.1. Designs are to meet certification requirements in the National Aeronautics and Space Administration (NASA) Policy Guide (NPR) 8820.2Gunder the Design portion of

the Facilities Project Requirements. Apply sustainable design principles to the design and construction of new facility systems. The essential elements of sustainability include the following:

1.10.1.1. Energy Efficiency.

1.10.1.2. Use of sustainable materials (i.e., reused, recycled, recyclable, non-toxic, low embodied energy content, renewable).

1.10.1.3. Emphasis on durability and efficiency of materials and equipment.

1.10.1.4. A healthy environment, including indoor air quality.

1.10.1.5. Features in support of enhanced worker productivity.

1.10.1.6. Design for personnel safety and security.

1.10.1.7. Provide Fall Protection for Operation and Maintenance (O&M) activities.

1.10.1.8. Design for future decommissioning and disposal.

1.10.1.9. Enhanced building operation and maintenance characteristics (i.e., Design for Maintainability, continued efficiency, and low toxicity).

1.10.1.10. A design meeting facility operational objectives that specifies testing and verification to assure that all building systems and components have been properly installed and perform to the level intended (i.e. Total Building Commissioning, TBC).

1.10.1.11. Comprehensive Procurement Guidelines (CPG): Incorporate recycled content elements of the CPG into the design to the extent feasible. Contractor to validate each design in writing, the use of CPG items, or rational for waivers. The CPG acknowledges, however, that specific circumstances may arise that preclude the purchase of products made with recovered materials.

1.11. Energy Conservation

1.11.1. When required by a Design Engineering Manager, provide a Design Engineering Project Content Checklist (ENG-F-DE60) completed for each Design package for all new facilities, or any modifications to existing facilities. This form verifies the designer has incorporated sustainability, life cycle costing, and energy efficiency into each section of the design where applicable and practicable for projects with a estimated construction value of $50K or higher. A more complete Energy Management Efficiency Guide can be found in NASA NPG 8831.2 Rev F, (Facilities Maintenance & Operations Management). NASA Technical Standards can be found at the NASA Standards and Technical Assistance Resource Tool (NASA Standards). Where applicable compare to ASHRAE Standard 90.1 2007 or later depending on what version was utilized during the initial design.

Note

Unique LOGIN is required for the NASA Standards and Technical Assistance Resource Tool.

1.12. Configuration Control System

1.12.1. It is the Lead Design Engineer's responsibility to coordinate with Configuration Management to determine required documentation for their individual project. Configuration Management to identify any project scope changing form, fit, and/or function, and/or changing the system from non- configured to configured with the assistance of the LDE and/or the assigned Design Engineers.

1.12.2. The Configuration Management Baseline Manager is responsible for the following:

1.12.2.1. Review the identification and support the coordination of documentation for baselines, systems, and equipment that require configuration control per Configuration Management Documentation System (CMDS) and Configuration Identification Document (CID), including new systems at turnover.

1.12.2.2. Initiate CID and support BOSS Baseline Managers in the development of CIDs to identify the portions of configured items under configuration control (and/or list exceptions) and specifies the levels of configuration control required. Assure definition is accurate, complete, clear, and understandable.

1.12.2.3. Record in CMDS the maintained/non-maintained status of design documents.

1.12.2.4. Review schedules and monitor status of all required Operations and Maintenance Documentation (OMD) products.

1.12.2.5. Provide controlled release of all OMD.

1.12.3. If the design is CONFIGURED it is required, according to ENG-P-0002, Configuration Management of Facilities/Systems/Equipment/Utilities (FSEU) to obtain Engineering Services Configuration Control Board (CCB) approval. Notify the assigned Baseline Manager to support this effort.

1.13. Room Numbering

1.13.1. When a design project requires the addition of new rooms, or the reconfiguration of existing rooms, new room numbers are assigned by Space Utilization and shown on the construction document drawings. Use these new room numbers on all applicable drawing schedules, i.e. room finish schedule, fire alarm schedule, etc.

1.13.2. When a new or reconfigured design affects the configuration of an area consisting of wall, door, cubical changes, and/or changes to the primary door entering an area; approval for proper numbering by the BOSS Space Utilization Department is required. This is in compliance with KNPR 8830.1, chapter 13, which states that by no later than the 60% design review the BOSS Space Utilization Department is provided the design for review. If in compliance, approval of the door/room numbering scheme is provided per KNPR 8830.1, 13.1. Send a drawing, preferably a Computer Aided Design (CAD) copy to KSC_BOSS_FloorPlans@nasa.gov; upon completion of the review, an approval and/or perhaps a red-lined drawing is returned. If at any time there are any additional changes to the configuration of the approved area, an additional review by the BOSS Space Utilization Department is required.

1.14. Pressure Vessel/System (PV/S) Design

1.14.1. Conduct Pressure Vessel design, alteration, modifications and repairs in accordance with KSC and industry design standards and comply with PVS certification requirements in NASA-STD-8719.17 and KNPR 8715.3.

Note

KSC Pressure System Manager to review and approve new designs, alteration, modifications, repairs, and design analysis prior to start of PV/S construction.

2. GUIDELINES FOR TECHNICAL DOCUMENTS

2.1. General

2.1.1. Includes any technical document such as statements of work, studies/evaluations, analyses, reports, implementation plans, and test requirements.

2.1.2. A request for an Engineering Technical Report is normally received from a Requester in the form of an EWR. The Work Type and Work Flow Type are determined by BOSS Work Control and a Work Order Number (WON) is created in Maximo, with task assignments made. It is REQUIRED that all completed Statements of Work (SOWs), Engineering Technical Reports, Studies, Data Manuals, and other Technical Documents be released through EDC. Use ENGINEERING EVALUATION form or ENG-F-STUDY, as a template in the preparation of the Engineering Technical Report or Study.

2.1.3. For details and guidelines in preparing a Technical Report, refer to KSC Technical Documentation Style Guide. (KSC-DF-107). The STATEMENT OF WORK TEMPLATE forms (ENG-F-SOW1 & ENG-F-SOW2) shall be used in the preparation of the Statement of Work. Use ENG-F-SOW2 for BOSS IDIQ Contractors.

3. GUIDELINES FOR PREPARING A ROUGH ORDER OF MAGNITUDE (ROM)

3.1. General

3.1.1. Requests for ROM's are received by a submitted EWR and normally have a ten (10) business day suspense for completion. Project Managers and Estimators are the primary POC's for ROM preparation, and will coordinate with the Design Engineer when they need technical support during ROM preparation. Reference ENG-I-PM02 for additional information on ROM preparation.

4. GUIDELINES FOR TASK ORDER PROJECTS THAT REQUIRE DESIGN

4.1. Project Planning Project

4.1.1. Planning is done via the approved Task Order scope of work, Maximo task lines (including the assigned hours and schedule), the software program Celoxis and referring to the completed Basis of Estimate (BOE). Refer to DMSO-ENG-21-004 for the BOE template and instructions for use.

4.2. Requirements Development

As soon as a NASA Task Order Manager (TOM) is assigned to a project, the BOSS Project Manager (PM) initiates a joint BOSS/NASA site walkdown and a Project Scoping Agreement (PSA) meeting with all the stakeholders and the design team to define the initial project scope, schedule, and budget. Once the scope has been adequately defined, it is documented and distributed to the key stakeholders in the form of a Project Scoping Agreement form ENG-F-PSA1. The form is signed off by the assigned BOSS and government representatives in accordance with ENG-I-PM02, Project Management Instructions.

4.3. Schedule

For Task Order projects, the Project Manager (PM) is responsible for developing the detailed project schedule, based on input received from the LDE, the design team and, when needed, from the LDEM and/or the Lead Engineer of one (1) or more Design Engineering Groups and in full coordination with the Requester, or government representatives. BOSS Instruction ENG-I-PM02 and the generic timelines provided in ESD-005 may be used as references in developing a detailed project schedule.

4.3.1. Task Order Schedule Changes - When problems arise that threaten current plan for completion, the PM and DE(s) will work together to establish a recovery plan to maintain the planned project completion date. If all measures have been taken to recover, yet schedule still cannot be achieved, the PM prepares a Project Change Request (PCR) form ENG-F-PM07, and obtains approval signatures. Complete this form as soon as it is apparent that the original schedule is unachievable, and in most cases approved well before the original completion date of the project.

4.4. Quality Standards

4.4.1. The LDE is responsible to ensure the submitted materials for review are at an acceptable level of detail for each design review prior to providing the design documents to the PM for setting up the design review meeting. For example, at 90% design completion, all design documents for all involved engineering disciplines are to be at least at that level. Architectural plans that are at 60% and mechanical plans at 90% do NOT constitute an acceptable level of detail for a 90% design review. If required, the LDE is responsible to coordinate the development of a recovery plan that will bringthe project quality and schedule back on track. The following must be informed by the LDE the details of the recovery plan: the PM, the design team, the DEMs, and the involved engineering discipline leads.

4.4.2. LDEs, through coordination with PMs and DE Managers (DEM), can determine the appropriate number and stage/quality of design milestones and associated documents. For projects requiring a complete design prior to construction advertisement; the minimum design milestones are 45 percent and 90 percent. Since the goal of all project work is to be cost effective, the LDE, PM, the Design Team, and the DEMs (as needed) can combine reviews dependent on the project size and scope. (Example: Scoping and 30% Design Review (DR) can be combined for smaller repetitive projects.)

4.4.3. Include the following minimum elements for these stages:

4.4.3.1. 30-Percent Design Documents

4.4.3.1.1. For new construction or an addition to an existing building, a site plan in accordance with the Center Master Plan.

4.4.3.1.2. A schematic floor plan, building wall sections, structural systems, mechanical systems, electrical systems, construction phasing plan, draft commissioning plan, and draft activation plan.

4.4.3.1.3. Design analysis supporting the basis for the design with calculations. Include important assumptions, standards, codes, and other constraints used to determine final selections.

4.4.3.1.4. Outline Specifications including specific manufacturer's specifications for key systems, equipment, or products.

4.4.3.1.5. 30-Percent Cost estimate, if needed, will be developed by the BOSS Cost Estimating Group.

4.4.3.2. 45/60-Percent Design Documents

4.4.3.2.1. A floor plan, building wall sections, structural systems, mechanical systems, electrical systems, construction phasing plan, commissioning plan, and activation plan all in the design development stage equal to either 45 or 60% complete respectively.

4.4.3.2.2. Specifications including specific manufacturer's specifications for key systems, equipment, or products, including input from supporting departments that are part of the design team.

4.4.3.2.3. Cost estimate equal to either 45 or 60% complete respectively – to be completed by the BOSS Cost Estimating Group, when needed.

4.4.3.3. 90-Percent Design Documents - The design documents submitted for review are a completely detailed set of technical design contract documents in their final form. They include the following:

4.4.3.3.1. A complete set of drawings and specifications with sufficient detail for a prudent contractor to complete the work. (Includes all input from Environmental and Safety groups.)

4.4.3.3.2. If needed, a complete cost estimate will be developed by the BOSS Cost Estimating Group.

4.5. Drawing Format

4.5.1. Comply with the latest version of BOSS Design Engineering Drafting and Drawing Conventions, ENG-H-0001, ENG-H-0001a, and ENG-H-0001b when compiling drawings.

4.5.2. Follow the following guidelines for the release of a quality product:

4.5.2.1. Obtain a drawing number from Engineering Documentation Center (EDC) at 867-3264. When calling, have the Work Order Number, Facility Number, and Title of the project ready.

4.5.2.2. Submit requests for Drafting support using form ENG-F-DE05.

4.5.2.3. Use the appropriate Title Block and use the National Aeronautics and Space Administration statement on all NASA projects.

4.5.2.4. Always show the Drawing Number, Work Order Number (WON) and the Electronic Work Request Number (EWR) on each sheet.

4.5.2.5. If a revision is being made, use the revision blocks located within the Title Block and fill it in starting from the right and working towards the left. List all releases of the drawings in chronological order and be sheet specific. Account for all Engineering Orders (EOs), including cancelled EOs, unused EOs, EOs not released, and incorporated EOs in the drawing revision block at its next revision release.

4.5.2.6. Identify all items on the drawings such as plans, sections details, etc. with a title and sheet coordinate reference number.

4.5.2.7. If the Design Architect/Engineer (A/E) is preparing their own drawing or is the Project Lead for an A/E designed package, the LDE is responsible to make sure that BOSS Design Engineering standards are followed. If there are any questions, contact the CAD Drafting Lead or the Manager of the CAD Drafting Group. Upon completion of the design and prior to DE sign off, it is the LDE's responsibility to confirm that copies of all details from the project are separated into their own files and placed into the CAD Standards/Inbox folder located in ProjectWise by the Project Lead Drafter.

4.5.3. Sketches

4.5.3.1. Sketches, rather than drawings, may be used when an engineering sketch is all that is necessary for a simple task, yet still require coordination/signatures per ESD-001, "Project Points of Contact". The Design Engineering Manager or the CAD Drafting Lead may authorize use of a sketch in lieu of a formal drawing. Typically, when the number of sheets in a sketch will go beyond three (3), a formal, full-sized drawing will be needed.

4.5.3.2. The Lead Engineer obtains a sketch number from EDC at 867-3264. When calling, have the Work Order Number, Facility Number, and Title of the project ready. A sketch also requires a Document Release Authorization (DRA) for official release. International Traffic in Arms Regulations/Sensitive But Unclassified (ITAR/SBU) requirements apply.

4.5.3.3. Sketches are often used to satisfy Design products that are implemented by the Shops, require less detail, and can be successfully constructed without specifications.

4.5.4. Construction Drawing Revisions/Engineering Orders (EO)

4.5.4.1. Once a drawing is approved and released, all changes to print are controlled and approved by Design Engineering either by an Engineering Order (EO),

revision to drawing, errata, or RFI Response form. Which change process to follow depends upon the phase of the project, criticality, and complexity of the change, and whether the drawing also serves as an operational configuration control drawing. Refer to procedure TDC-P-0001, Control of Engineering Documentation, for further detail. Engineering judgment of the DE and Design Engineering Manager (DEM) determines which process best suits the situation. The following is offered as guidance when making the decision of which document change process to use:

4.5.4.1.1. Make an EO, errata, or revision prior to advertise and award.

4.5.4.1.2. During advertise and award, and construction phases, an RFI Response form alone is adequate.

4.5.5. Construction Drawing EO Formats

4.5.5.1. Prepare page one (1) of all EOs using form KSC FORM 50-191, Engineering Order.

4.5.5.2. From - To Format: “A” sized sheets, typically with the “From” detail cut and pasted from drawing to one “A” size sheet and the “To” detail change sketched by Engineer on another “A” size sheet.

4.5.5.3. Full Size EO: A full size EO is simply the drawing sheet changed to show the new content. The new content is typically clouded and the title block is crossed out with an X and the EO number is placed directly above. Depending upon the content and complexity of this sheet, it may be satisfactory to plot this sheet as “B” or “C” size.

4.5.5.4. ITAR and SBU requirements apply to all documents being released into EDC per QAL-P-0022.

4.6. Specification Preparation and Standards

4.6.1. Compile construction specifications using NASA’s SPECSINTACT freeware system and its associated text file database in accordance with ENG-I-DE23, Creation of Construction Specifications. SPECSINTACT precedence of use is as follows: the BOSS Master, the NASAKSC Local Master, and UFGS Guide Specification Masters (NASA is an active UFGS member). Editing notes in the texts are guides, and the Engineer is fully responsible for the technical contents of the resulting project specifications.

4.6.2. When editing and compiling specifications conform to ENG-I-DE23.

4.6.3. SpecsIntact is an automated system that utilizes standardized facility construction specifications. Used worldwide by the National Aeronautics and Space Administration (NASA), the U.S. Naval Facilities Engineering Command (NAVFAC), and the U.S. Army Corps of Engineers (USACE), SpecsIntact makes it possible to assure quality control for project specifications from beginning to the end. The SpecsIntact system is managed at the Kennedy Space Center and used by engineers, architects, specification writers, project managers, and construction managers doing business with all government agencies. Unlike many specification programs today, SpecsIntact and the UFGS Master are available at no charge as it is a government funded application. Using SpecsIntact reduces the time and expense required to produce facility specifications, and

helps eliminate costly construction changes due to omissions, discrepancies, or improper quality control.

4.7. Design Data Manual

4.7.1. Design Data Manuals are only required to be developed when it is included in the scope of work of an approved Task Order or when a Design Engineering Manager requires it's development. The level of detail included in a Data Manual, when one is required, is based on a graded approach. When applying the graded approach, consideration is given to the potential impact that the Form, Fit, or Function (FFF) has on the safety of a Facility, System, Equipment, and Utilities (FSEU). A typical Data Manual includes historical data assembled during the course of design. Place all hand calculations, sketches, and other manually produced documentation in the Data Manual. Tab each section heading and number all sheets sequentially. Miscellaneous documentation may be added to the Data Manual at the end as Appendices. Provide the following Headings and information:

4.7.1.1. Project Description – A general description of the overall project, with a definitive description of the site, civil, architectural, structural, mechanical, and electrical systems (including subsystems). Use the Project Scoping Agreement (PSA) to meet this requirement.

4.7.1.2. Historical Record – The original scope of work, along with changes/deletions/additions made during the design cycle. Use a revised PSA form ENG-F-DE36 to meet this requirement, or the Project Action Tracker form ENG-F-PM02 to meet this requirement.

4.7.1.3. Design Philosophy – The design approach and the reason for selecting the specific site, structural, mechanical, and/or electrical systems; a listing and discussion of the factors considered (whether or not utilized) that had a direct or indirect influence in the design.

4.7.1.4. Design Considerations – A discussion of value engineering, life-cycle costing, long-lead items, energy sources and conservation, maintenance, operations, safety, industry standards, special requirements, environmental factors, and methods of construction. Refer to the Appendex section for applicable standards by discipline. Use the Design Engineering Project Content Checklist ENG-F-DE60 to meet this requirement.

4.7.1.5. Concept Sketches – Working sketches of all concepts, whether final selected or not, that depicts the function flow, clearances, and tolerances required.

4.7.1.6. Controlling Documents – A list of the codes, specifications, technical publications, etc. used in the design whether or not the documents appear herein.

4.7.1.7. Design Calculations – Submit detailed calculations with the 90% and the final submittals. Within the design calculations include a statement of the purpose for the calculation and assumptions made, a definition of the symbols used, explanation of the assumptions and conclusions, the signature of the person who performed the calculations, and the approval signature of the Engineer of Record (or delegated

Engineer, as appropriate). Use of computerized engineering software does not void the requirement to provide complete calculations as stated herein.

4.7.1.8. Equipment and Warranty Matrix.

4.7.1.9. Vendor Cut Sheets that serve as the basis for design – as applicable.

4.7.2. When the development of a formal Design Data Manuals is not required, much of the information listed above must still be saved and be located in the electronic shared folder for the project.

4.8. Construction Cost Estimates

4.8.1. All Construction Cost Estimates, including ROMs and more detailed estimates, are developed by the BOSS Cost Estimating Group within the Engineering Department. Refer to BOSS Procedure ENG-P-EST01 for information pertaining to the development of Construction Cost Estimates.

4.9. Design Review Meetings

Formal Design Reviews are held at different milestones of a project, as necessary, to verify and validate that the design is meeting the technical and customer requirements. The number of meetings is determined by the LDE and depends on the complexity and risk of the project. The Project Manager schedules the meeting and distributes the design documents to all who are invited. Formal Design Review Meeting Notifications are required on all formal design reviews. The Project Manager sends the design review meeting notice out at least a week in advance of the meeting, to allow enough time for participants to perform an adequate review. Required invitees to the various FP design review meetings are identified on form ESD-001. For baseline design reviews, follow the intent of, with inclusion of participants determined by the LDE, based on a graded approach.

4.9.1. Format for Meeting Notice Distributions

4.9.1.1. Distribute Design Review packages via email with a link to a common SHARE folder or utilize Large File Transfer. The Project Folder is in the format of “WON XXXXXXXX Project Title and Fac. Number”. Point clearly to Folder “WON XXXXXXXX Project Title and Fac. Number” for all correspondence or meeting notices that relate to the subject folder and contents. Using nick-names or quick references is not acceptable.

4.9.1.2. Provide CLEAR file names for the Project Documents (Drawing, Specs, Haz Mat testing etc) to include the 81K number, Design Review Milestone, and Product (spec, dwg, etc.). Example: 81K54387-90%-Specifications; or 81K54387-90-Dwgs.

4.9.1.3. Clearly identify the name so all laypersons can easily determine from the File Name, what the content is.

4.9.1.4. Upon posting Design Review Documents, remove previous DR milestone documents that no longer apply. That is, when posting a 90% Package, remove the

45% Package. Some items such as Safety Checklist, Environmental Requirements, Material Testing etc. can remain ONLY if they are relevant to the current Design Review.

4.9.1.5. The Project Manual, when one is developed, which includes the Technical Specifications, Submittal Register, Safety and Environmental Requirements documents and forms, are to be posted as a SINGLE file, in PDF format. There may be a need to rename files to ensure they are CLEAR to all stakeholders.

4.9.1.6. Drawings are to be posted as a SINGLE file, in Portable Document Format (PDF). There may be a need to rename files to ensure they are CLEAR to all stakeholders.

4.9.1.7. All meeting notices that request recipients to review documents on the server need to contain full explanation of what the purpose of the meeting is, including the hyper-link and CLEAR directions on where to find the documents you expect them to review. Attach a Design Review Meeting Agenda - Minutes form (ENG-F-PM14). Example e-mail notice format:

> *BOSS Engineering is developing construction documents to repair and replace hurricane damage to the Engineering Development Lab (EDL) Building M7-0409. Project involves removal and replacement of existing BUR, gutters, downspouts, and roof penetrations, and replacing with 4-ply roofing system.*
>
> *A PDF copy of the 45% Design Drawings and Specifications (file name – 81K54378-45-dwgs, 81K54378-45-specs) are available for downloading at* \\bossfile\engineering$\Shared\ISC_Review_Packages Folder.
>
> *Request you review these documents and provide written comments on the Engineering Review Comments Form (ENG-F-DE34) provided. If you do not have any comments, please submit a "No Comments" response. Comment/No Comment responses are due NLT 9/6/21 (*Design Review Meeting Date*). Agenda for the review meeting is attached.*

4.9.1.8. Using DR meeting agenda/minutes form (ENG-F-PM14) the PM provides a meeting agenda with the meeting invitation to all reviewers.

4.9.1.9. Allow stakeholders a MINIMUM of five (5) business days for technical review of the Design.

4.9.2. Design Review Meeting Format

4.9.2.1. The PM chairs the design reviews (unless coordinated otherwise within the Design Team). Key design team personnel are expected to participate in each review. Prior to each meeting, review all review comments received and provide disposition if possible. Present for discussion all comments during the design reviews. Record the dispositions and follow up by incorporating the agreed disposition actions into the design drawings and specifications.

4.9.2.2. Each review conference consists of a summary presentation, discussion of review comments, and assignment and/or review of actions. The Chairperson records the dispositions, and the LDE follows up by incorporating the agreed disposition actions into the design package. The following disposition codes are utilized and recorded for each review comment:

- ACCEPTED (“A”) – the comment is within scope and will be incorporated as stated.
- ACCEPT INTENT (“AI”) – the comment will be incorporated in an appropriate manner that satisfies the comment’s intent.
- REJECTED (“R”) – the comment will not be incorporated.
- STUDY (“S”) – the validity or the impact of the comment cannot be assessed during the review. Additional information or action will be pursued before providing a definitive disposition.
- WITHDRAWN (“W”) – the comment is withdrawn by the originator or the originator’s representative.

4.9.2.3. Provide dispositions of Review Comments and minutes of design review meeting to all stakeholders, and attendees within five (5) working days after each review. Minutes are to reflect action items assigned during the review meeting and associated suspense for follow-up. Use Design Review meeting agenda - minutes form, (ENG-F-PM14).

4.9.2.4. For those comments where accept or reject statement is not sufficient to determine the engineering course of action, provide a brief explanation of the accepted action. For example, if the engineering review comment reads, “Change note 2 material sources from GFE to CFE”, and then a simple accept or reject is sufficient. However, if the comment reads, “Note 2 doesn’t indicate the material source”, then a comment response such as, “Accepted – note changed to indicate CFE source”, would be more appropriate.

4.10. Quality Assurance/Control

Engineering Peer Review - The LDE and the Design Engineer define and implement Engineering Peer Review/Reviews (EPR) for the product commensurate with the scope, complexity and acceptable risk of the design. Conduct multiple peer reviews, as appropriate, over the lifecycle of each project consistent with the evolving design and development.

4.11. Peer Team Members

4.11.1. Engineering peer review teams, or an individual Engineer, are comprised of technical experts with significant practical experience relevant to the technology and requirements of the Facility, System, Equipment, and Utilities (FSEU) to be reviewed. All review team members are independent of the project/product team; i.e. not a participant in the project/product team. The goal is an independent review with a variety of perspectives, experiences, and processes considered. Technical experts from outside of DE, and other organizations participating in the project, may be included as necessary.

4.11.1.1. Conducting Engineering Peer Reviews (EPR)

4.11.1.1.1. The depth of the EPR is commensurate with the scope, complexity and risk of the project design under review. The EPR may range from a multidiscipline team, meeting several times during the life cycle of the design to a single qualified Engineer or DEM performing a review at the 100% stage of the design.

4.11.1.1.2. AT A MINIMUM, all designs have one (1) Engineer or DEM, qualified in each of the specific disciplines; review the technical content of the design.

4.11.2. Final Design Package

4.11.2.1. Final Design Package Contents

4.11.2.1.1. Drawings - Final Design Drawings include as a minimum a completely detailed set of Drawings that clearly depicts required work in sufficient detail for a prudent contractor to complete the work. Drawings are checked in all disciplines, and signatories validating that the details and instructions meet or exceeds requirements set forth by the PSA, and subsequent Technical Design Reviews. Required stakeholder signatures are identified in ESD-001.

4.11.2.1.2. Specifications - Completely detail Final Design Specifications such that they clearly depict required work and material requirements in sufficient detail that a prudent contractor can complete the required work. Check Specifications in all disciplines, validating that requirements have been met for the project.

4.11.2.1.3. Project Manual Attachments - Add attachments following the Technical Specification Package to include as a minimum:

4.11.2.1.3.1. Submittal Register: Translate the auto-generated Submittal Register into MS Excel, to allow the Engineering Team to refine the auto-generated register to minimize superfluous submittal requirements that would unnecessarily escalate project cost. File the Microsoft Excel Submittal Register with the Original Specification Package in EDC, and the electronic version kept with the other electronic files.

4.11.2.1.3.2. Safety Plan Requirements: Are generated by BOSS Safety, and address project specific requirements of SHP-P-1926.

4.11.2.1.3.3. Environmental Requirements: Are generated by BOSS Environmental Assurance, and address project specific requirements of EAP-P-4800A BOSS Environmental Requirements for Contracted Projects.

4.11.2.1.3.4. Hazardous Materials Testing Results: The LDE includes Test results that could prove useful for the successful contractor to ensure his people receive required hazard communication prior to work.

4.11.2.1.4. Final Cost Estimate - A Final Project Cost Estimate as provided by the PM.

4.11.3. Quality Assurance Review - Quality Assurance Review (QAR), when required, is a general review that supports the format and file structure of any design project. The purpose of a QAR is to add value and reduce risk through the repetitive and consistent use of established CADD Standards and Drawing Conventions. A QAR provides an examination of drawing configuration, format, layout, cross referencing, symbols,

schedules and electronic file structure to help verify the drawing package provides the bidding contractor the information needed in an easy to follow format. Reference ENG-I-CS01, CADD Standards Drawing Review Instruction, for specific instructions related to this review. Quality Assurance Reviews are in addition to Peer Reviews and are only performed when required by the Design Manager.

4.12. Design Phase Closeout Meeting

The PM conducts a close out meeting at the end of the design phase to discuss lessons learned and best practice efforts. The PM documents detailed information on Lessons Learned/Best Practices form ENG-F-PM05 and submits the form to the Engineering Services Department Manager, the PM Manager, and the Design Engineering Managers upon 100% design completion.

4.13. Guidelines for Joint P&E/Design Engineering Design

Design Engineering is a support organization that provides professional engineering support throughout the contract. As such, there are occasions where Design Engineering support is required outside of a Task Order environment. Routine and low risk projects are prepared by Planning & Estimating (P&E) typically for Shop Implementation. P&E sometimes requires Design Engineering (DE) support on these projects. CCB coordination support by DE is requested by P&E via email and notating it in Maximo.

4.14. Guidelines for Move/Mod Designs

Move/Mod designs follow the applicable space utilization guidelines when designing facility utilization layouts for moves and minor modifications commonly known as Move/Mods. A thorough BOSS instruction is available to use as a guideline for these types of projects. Refer to ENG-I-MM01.

4.15. Guidelines for Operations and Maintenance Documentation (OMD) Updates/Creation of Maintained Documents

4.15.1. Initial review of required documentation to ensure all required red-lines, as-built, etc. are available to create or update any and all configured documentation occurs at two points in the OMD process:

4.15.1.1. Notice of Impending Turnover (NoIT) – an email sent by Activation and Turnover (A&T).

4.15.1.1.1. DE has ten (10) days to complete this review.

4.15.1.1.2. A&T will take the action to contact the appropriate parties regarding missing or inadequate documentation.

4.15.1.2. Doc Closure - an email sent by Configuration Management advising a project has entered the doc closure phase and a request to review documentation for accuracy and completeness.

4.15.1.2.1. DE has ten (10) days to complete this review.

4.15.1.2.2. Configuration Management will take the action to contact the appropriate parties regarding missing or inadequate documentation.

4.15.1.3. OMD must be completed within ninety (90) days of baseline work changes to FSEU, and as negotiated per task order related OMD efforts.

4.15.1.3.1. For baseline OMD, If the 90-day update requirement cannot be met, request an extension via the applicable branch manager. Documents should be reviewed as soon as possible within the 90-day review cycle, to assess required resources and timelines to complete. Extensions should be avoided wherever possible, and if needed, are expected to be requested early within the OMD update process.

4.15.1.3.2. The Branch Manager will provide justification to the Engineering Services (ES) Manager, with cc to Configuration Management. If the extension is approved by the ES Manager, Configuration Management will petition the BOSS CCB to approve additional time for OMD completion.

- Justification such as the need for a field walk down or additional data gathering or the extensive volume of sheets requiring updates may be approved for extension.
- Justification due to staffing will not be approved.

4.15.1.3.3. For Task Order OMD, if the contractual PoP date cannot be met, coordinate with the assigned Project Manager to request an extention.

4.15.2. Document Update

4.15.2.1. Assess current document configuration and identify changes required. (Note: field validation may be required)

4.15.2.2. Consult with SE to identify any additional or specific information to be included.

4.15.2.3. Determine if an EO (Engineering Order) or revision is required.

4.15.2.4. Redline to reflect changes and denote in revision block the project that made the changes.

4.15.2.5. Define and include notes as necessary to reference the drawing (or document) that resulted in the changes configuration (i.e. Vendor drawing/document number, 81K, etc).

4.15.2.6. Provide redlines to drafting (as required) and identify due date/priority.

4.15.2.7. Review draft for completion, edit as necessary.

4.15.2.8. Once complete, provide advanced copy to the appropriate SE for review.

4.15.2.9. Resolve any issues and prepare for release through EDC (Engineering Document Control).

4.15.3. Release

4.15.3.1. Identify all parties requiring notification of document release. This includes as a minimum; the SE and government SME.

4.15.3.2. Provide the applicable Baseline Manager the document(s) for release and distribution list.

4.15.3.3. Upon receipt of a completed DRA; obtain required signatures, make a copy of the DRA for the package and return the signed DRA and applicable document(s) to the Baseline Manager for final release into EDC.

4.16. Saving Engineer Files in ProjectWise

4.16.1. Design working files and final files are saved in ProjectWise. ProjectWise is an application that unifies project information in a single environment, so anyone on the project team can easily access it. ProjectWise provides access and current project information to anyone we have designated--anytime, anywhere. ProjectWise allows a single, consistent resource for all project information. Save the following information in ProjectWise:

- CADD Files
- Cost Estimates
- Photographs
- Design Review Invitations and Minutes Review invoices
- Correspondence
- Analysis & Calculations
- Configuration Information
- Environmental Information

4.16.2. When a design assignment enters DE, a folder is created in ProjectWise. The folder is identified by the Project Number, WON, and Project Title. During the design process save work in progress and to exchange data among the design team using ProjectWise. At design completion; save all final files to ProjectWise.

4.17. Document Release Authorization (DRA) KSC Form 21-68 (KSC Forms)

The DRA is the official document used for releasing design documentation to the Engineering Documentation Center (EDC) in accordance with ENG-P-0002 AND KDP-KSC-P-1537, “Document Release Authorization (DRA) Process”. In order to expedite the process it is important that the applicable Configuration Baseline Manager (BLM) be provided with a preliminary copy of the project description. The BLM can then review and comment and start the preparation of the DRA prior to the final release to EDC.

4.18. Special Design Review Support

Request for Information (RFIs)/Submittals/Technical Evaluations (TEs)

4.18.1. RFIs, Submittals, and Technical Evaluations (TEs) are construction phase documents. See procedure ENG-P-0018 for detailed description related to RFIs, Submittals, and TEs. All RFIs, Submittals, and TEs are to be reviewed, responded, and

returned to originating agency within seven (7) calendar days of contract receipt. Note: there may be a need for additional review by SE and NASA System Engineer (NSE) for all Major Component (MCs) submittals. If, for some reason, the response is anticipated to take longer than seven (7) days, the Engineer is required to discuss the details with their Manager. Communicate any extension beyond seven (7) calendar days with our customers to keep them advised of the situation. If the due date is missed, send an email prior to seven (7) calendar days from when EPC received the document to the EPC point of contact, Subcontracts Administrator, Construction Inspector, and Project Manager, briefly explaining the need for an extension.

4.18.2. The following forms are used in the preparation of RFIs, Submittals, and TEs:

- RFI Response form – PRO-F-RFI
- Task Order Submittal Form – PRO-F-SSF
- Design/Construction/Shop Cost Estimate form – ENG-F-DE11
- Technical Evaluation Response form – ENG-F-PM12

4.18.3. Submittal Processing - The customer's form, provided with the submittal package, is used to respond to the contractor's submittal package. If the response is approved as noted or rejected, provide a brief explanation identifying the deficiency.

4.18.3.1. DE shall review submittals provided to ensure compliance with specifications (e.g. electronic media provided in proper format, as-built, etc).

4.18.4. Review/Refresh Update of Previously Released DE Designs

4.18.4.1. DE to review any past designs, which have been signed off and released for more than twelve (12) months, prior to issuance for construction. The review considers any changes to code, standards and customer's requirements. Generally, a recycle to a 90% review meeting is good practice to reveal any changes and to ensure all stakeholders are in support of the design.

4.18.4.2. Complete a new ENG-F-DE46 for all refreshed designs. The applicable design team member verifies that all actions identified on the Engineering Design Checklist are already complete and up to date, or have been revised during the design refresh process.

4.18.4.3. Review and updating of the specifications and cost estimates are required. All sections within the specifications are cross referenced to the current SpecsIntact database at time of review in reference to the "master date". All Division 1 sections are updated with the current sections. Replace and/or update Divisions 2 through 50 if the section is more than twelve (12) months old and a more current version is available. A cost impact versus value added assessment needs to be made to determine the best avenue to accomplish changes. Have the cost estimate updated by the person that created it, i.e. if it was created by the Cost Estimating group then in should be reviewed and updated by them. If the project is under $50k and DE personnel created it then that same person/team should review/revise the cost estimate.

4.18.4.4. The Lead Engineer's Manager determines the level of review necessary for the design. If any technical changes are necessary, the design drawing is routed for approval signatures prior to reissuance.

4.18.4.5. Review of Designs by Others and Executed by Others - DE reviews designs by others which affect BOSS systems, facilities, and equipment when DE's contribution is considered important to ensure BOSS operating, maintenance, reliability, and system configuration requirements are satisfied. Focus the engineering effort on these reviews on the fundamental engineering decisions and is not intended to be a quality or peer review. Spend time considering whether the interface with existing systems is appropriate, use of the current codes is invoked, consideration of maintenance life cycle costs are considered and related high level activities. Unless specifically authorized by the Branch Manager, engineering time is not to be spent critiquing format, performing a quality review of calculations, correcting typos, and related detailed activities.

APPENDIX A: DESIGN STANDARDS USED BY SECURITY/FIRE ALARMS/ CONTROLS/ ELECTRICAL DE

Security:

- NFPA-731 – Standard for the Installation of Electronic Security Premises (This is a PWS / BOSS Requirements Standard that we need to meet)
- DCID 6/9 – Physical Security Standards for Sensitive Compartmented Information Facilities (Although not listed as a BOSS Contract Requirements document, it must be met for SCIF projects)
- UL-681 – Installation & Classification of Burglar and Holdup Alarm Systems
- KNPR 1600.1 – KSC Security Procedural Requirements (Chapter 8 – Technical Security Safeguard Systems) This may be a BOSS Requirements Standard Document

Fire Alarms:

- KSC-STD-F-0004F – Design Standard for Fire Protection
- NASA-STD-8719.11 Rev A – Safety Standard For Fire Protection
- NFPA 72 – National Fire Alarm and Signaling Code, 2010 Edition
- NFPA 101 – Life Safety Code®, 2012 Edition
- ADA – Americans with Disabilities Act
- UCF 3-600-01 – Fire Protection Engineering for Facilities (USAF Facilities Only)
- For a complete list of NFPA Fire codes see link: http://codesonline.nfpa.org/NFPA/a/fulltoc

Controls:

- 80K02217 – KCCS Software Architecture Specifications
- 80K02218 – KCCS IED Tag List Directory
- 80K59338 – KCCS System Level Specification
- CEA-709.1-B – Consumer Electronics Association Control Network Protocol Specification
- ANSI/CEA-709.2-A – American National Standards Institute/ Consumer Electronics Association Control Network Powerline (PL) Channel Specification
- ANSI/CEA-709.3 – ANSI/CEA Free-Topology Twisted-Pair Channel Specification
- ANSI/CEA-709.4 – ANSI/CEA Fiber-Optic Channel Specification
- IEC Standard 61131-1 – International Electro-Technical Commission Programmable Controllers – Part 1 General Information
- KSC-STD-F-0004F – Design Standard for Fire Protection
- KSC-DD-804 - KCCS Design Guide
- ENG-P-0025 -FSEU Software Control

- ENG-P-0030 - Roles And Responsibilities For Industrial Control Systems Administrators
- Forms: ENG-F-SWREL - Software Release Form

Power Systems:
- NFPA 70 – The National Electric Code (NEC)
- NESC (IEEE C2) - National Electrical Safety Code
- IES Lighting Handbook
- NFPA 70E -Standard for Electrical Safety in workplace
- IEEE STD 241 – “Gray Book” - Power systems in commercial Buildings
- IEEE STD 242 – “Buff Book” - Coordination and protection of Power systems
- IEEE STD C57.109 - Guide for Protecting Power Transformers
- IEEE STD 141 – “Red Book” - Electrical Power distribution Standard for Industrial Systems
- IEEE STD 399 – “Brown Book” - Recommended Practices for Industrial and commercial Power Systems
- IEEE STD 519 – Recommended Practices and requirements for Harmonics Control in Electrical Power systems
- 79K17429 – KSC Power Distribution System
- AFI 32-1062 – Electrical Power Plants and Generators (USAF Facilities Only)
- AFI 32-1063 – Electrical Power Systems (USAF Facilities Only)

Grounding and Lightning Protection:
- NFPA 780 - Standard for the Installation of Lightning Protection Systems
- KSC-STD-E-0012E – KSC Standard for Facility Grounding and Lightning Protection
- UL 96A - Installation Requirements for Lightning Protection Systems
- IEEE STD 142 —“Green Book” - Recommended Practice for Grounding of Industrial and Commercial Power Systems
- AFI 32-1065 – Grounding Systems (USAF Facilities Only)

Arc Flash:
- NFPA 70E “Standard for Electrical Safety in the Workplace”, 2009
- C2-2007 IEEE NESC “2007 National Electrical Safety Code”
- Forms: KSC Form 50-103 NS, Energized Electrical Work Analysis & Authorization Permit

General Standards:
- KNPR 8715.3 “KSC Safety Practices Procedural Requirements”
- KNPR 8700.2 “KSC System Safety and Reliability Analysis Methodology Procedural Requirements”
- NASA-STD-8719.7 “Facility System Guidebook”

- SHP-P-0132 “Personal Protective Equipment”
- SHP-P-0146 “Confined Space Program”
- SHP-P-0147 “Hazardous Energy Control (Lockout/Tagout)”
- SHP-P-0303 “Electrical Safety”
- SHP-F-0303 “Energized Electrical Work Analysis & Authorization Permit Cover and Approval Sheet”
- NFPA 101 "Life Safety Code"
- NFPA 110 “Standard for Emergency and Standby Power Systems”
- KSC-DE-512-SM "Facility Systems, Ground Support Systems, and Ground Support Equipment General Design Requirements"
- NNK08OC01C “BOSS Performance Work Statement”

APPENDIX B: DESIGN ENGINEERING STANDARDS – ARCHITECTURAL/STRUCTURAL/CIVIL

Architectural:

- AAMA – (1995) Window Selection Guide
- AWI QSGSQCP – (2008) Architectural Woodwork Quality Standards Illustrated
- ANSI/BHMA A156.6 – (2010) Architectural Door Trim
- MPI ASM – (2004) Architectural Painting Specification Manual
- SMACNA 1793 – (2003) Architectural Sheet Metal Manual, 6th Edition
- ARMA 410BUR88 – (2001) Manual of Roof Maintenance and Repair
- ARMA 460LSR97 – (2002) NRCA/MRCA Repair Manual for Low Slope Membrane Roof Systems
- GANA Glazing Manual – (2008) Glazing Manual
- GANA Sealant Manual – (2008) Sealant Manual
- GA 600 – (2009) Fire Resistance Design Manual
- ICC IBC – (2009; Errata First Printing) International Building Code
- ICC IFC – (2009) International Fire Code
- ICC/ANSI A117.1 – (2009) Accessible and Usable Buildings and Facilities
- MBMA MBSM – (2002) Metal Building Systems Manual
- MBMA RSDM – (2000) Metal Roofing Systems Design Manual
- NASA-STD-2008A – (2011b) Protective Coating of Carbon Steel, Stainless Steel, and Aluminum on Launch Structures, Facilities, and Ground Support Equipment
- NFPA 101 – (2012; Amendment 1 2012) Life Safety Code
- NRCA RoofMan – (2012) The NRCA Roofing Manual
- SSPC Painting Manual – (2002) Good Painting Practice, Steel Structures Painting Manual, Volume 1
- LEED – (2002; R 2005) Leadership in Energy and Environmental Design™ Green Building Rating System for New Construction (LEED-NC)
- LEED Reference Guide – (2005) LEED-NC Reference Guide for New Construction

Structural:

- PCI MNL-122 – (2007) Architectural Precast Concrete, 3rd Edition
- ACI/MCP-1 (2011) manual of Concrete Practice Part 1
- ACI/MCP-2 (2011) manual of Concrete Practice Part 2
- ACI/MCP-3 (2011) manual of Concrete Practice Part 3
- ACI/MCP-4 (2011) manual of Concrete Practice Part 4
- AISC 325 – (2011) Steel Construction Manual
- AISI D100 – (1991; R 2008) Cold-Formed Steel Design Manual
- AWS-03 – (2001) Welding Handbook, Volumes 1 thru 4
- CRSI 10MSP – (2001; 28th Ed) Manual of Standard Practice
- FM DS 1-28 – (2002) Design Wind Loads
- ICC IBC – (2009); Errata First Publishing) International Building Code

- ICC UBC – (1997; Erratas Vol 1, 2 & amp; 3 01/2001; Vol 1 & amp; 2 03/2001; Vol 2 10/2001) Uniform Building Code
- MBMA MBSM – (2002) Metal Building Systems Manual
- NASA-STD-2008A – (2011b) Protective Coating of Carbon Steel, Stainless Steel, and Aluminum on Launch Structures, Facilities, and Ground Support Equipment.
- PCI MNL-120 – (2010) PCI Design Handbook – Precast and Pre-stressed Concrete, 6th Edition
- SSPC SSPM – (2010) SSPC Painting Manual, Volume 2, Systems and Specifications
- SJI LOAD TABLES – (2005; Errata 1 2006; Errata 2 2007 Errata 3 2007) 42nd Edition Catalog of Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders
- SJI MANUAL – (2009) 80 Years of Open Web Steel Joist Construction

Civil:

- AASHTO HB-17 – (2002; Errata 2003, Errata 2005, 17th Edition) Standard Specifications for Highway Bridges
- AASHTO RSDG-4 – (2011) Roadside Design Guide
- AREMA Eng Man – (2010) Manual for Railway Engineering
- ASCE 7-10 – (2010; Change 2010; Change 2011; Errata 2011; Change 2011) Minimum Design Loads for Buildings and Other Structures
- AWWA M14 – (2004; 3rd Ed) Manual: recommended Practice for Backflow Prevention and Cross-Connection Control
- AWWA M23 – (2002; 2nd Ed) Manual: PVC Pipe – Design and Installation
- AWWA M9 – (2008 3rd Ed) Manual: Concrete Pressure Pipe
- ICC IBC – (2009; Errata First Printing) International Building Code
- ICC UBC – (1997; Erratas Vol 1, 2 & amp; 3 01/2001; Vol 1 & amp; 2 03/2001; Vol 2 10/2001) Uniform Building Code
- NASA-STD-2008A – (2011b) Protective Coating of Carbon Steel, Stainless Steel, and Aluminum on Launch Structures, Facilities, and Ground Support Equipment.
- SSPC SSPM – (2010) SSPC Painting Manual, Volume 2, Systems and Specifications

RECORDS

The following records are retained by the organizations listed below:

Record	Responsible Organization	NRRS/Item#	Retention Period
Design Drawings, Specifications & Data Manual	Engineering Services	08/048.0.A.02.B	Retain on-site for 3 years after completion of construction or until after final payment. Destroy within one year after demolition of structure. [DA: N1-255-00-1] [DA: N1-255-09-1]

ROLES AND RESPONSIBILITIES

BOSS Program Manager: Ensures BOSS compliance to the requirements stated in this procedure. Reviews and approves or disapproves waiver requests written against this standard.

Manager: Ensures compliance within the Division to the requirements stated in this procedure.

Branch Manager: Ensures compliance at the branch level to the requirements stated in this procedure.

Design Engineering Manager (DEM): Ensure overall quality, content, and timeliness of the Engineering Products developed by their section. Ensure coordination among their engineering resources to support the LDE. Ensure that a Quality Assurance/Quality Control process is completed so engineering products released meets or exceeds customer expectations. Provide input and approve design, assigned man-hours, and schedule requirements identified for their section.

Lead Design Engineer Manager (LDEM): The Manager of the assigned Lead Design Engineer. In addition to responsibilities as shown for the DEM, the LDEM determines the number of design reviews required based on a graded approach. The graded approach determines the rigor with which engineering requirements are applied (engineering analysis, documentation, approval, and review are based on facility/system specific factors). When applying the graded approach, consideration is given to the potential impact that the Form, Fit, or Function (FFF) has on the safety of a Facility, System, Equipment, and Utilities (FSEU).

Ensure the submitted materials for review are at an acceptable level of detail for each design review before the design review meeting is set.

Lead Design Engineer (LDE): Single technical point of contact for the Design Team to coordinate the design efforts internally with the Design Team (Support Engineers,

Drafters, Configuration Management, Costs Analyst, System Maintenance Engineers (within Propellants & Life Support), System Engineers, Chief Engineer (CE), Fire Engineering, Safety & Quality, Environmental, Facility Manager, and other "mandatory distribution" contacts).

The LDE is the primary technical point of contact with the Project Manager (PM). The LDE assumes the roles and responsibilities of the PM for any in-house non-Task Order projects where a PM has NOT been assigned. These responsibilities and duties are outlined and described in the Project Management Instruction (ENG-I-PM02).

Identify and verify/validate all scope requirements with the EWR Requester, System Engineer (SE) and other technical stakeholders as appropriate to secure a full understanding of the project scope. The LDE is responsible for communicating these requirements to all of the Supporting Engineers and the Design Team. Provide all technical content for the Project Scoping Agreement (PSA) (ENG-F-DE36).

Ensure, for all configured systems, that the documentation requirements are understood and listed on the Project Summary and Documentation Planning Form PCMS-DE10. Coordinate with the associated Baseline Manager during all phases of the project to validate documentation requirements. If the project is configured, obtain approval by the FSEU CCB.

Continuously assess Design Team's ability to provide a quality design project while meeting assigned project scope, initial or updated design schedule milestones, and initial or updated design assigned man-hours.

Report all changes in project scope, project design schedule, and design assigned man-hours to the LDEM. All changes in scope, schedule, or design assigned man-hours from the Design Team are coordinated and approved by the LDEM, prior to approval by the PM, and final approval by the Government.

Review and validate the Environmental Checklist (KSC Form 21-608V2) KSC FORM and associated response document, and the Design Engineering Standards Checklist ENG-F-DS60 as part of the design package. The Engineering Design Checklist (ENG-F-DE46) is a guide to be used in preparing the design package.

Determine, in conjunction with the DEM, how many design reviews are appropriate and when they are to be held and determine the Engineering Peer Review (EPR) requirements.

Participate as Technical Lead for all design review (DR) meetings.

Develop a commissioning test plan requirements, if the project warrants commissioning, such as in the case of PLC-controlled systems, HVAC systems, and instrumented systems in general.

Merge all support documents into one (1) design package from Supporting Engineers and others who had involvement with project; i.e. drawings, cost estimate, specifications, data manual, checklists, permits, siting, environmental (testing/samplings/surveys), safety and health inputs, and Configuration Management's ENG-F-DE10 form.

Develop technical evaluation bid criteria and provide to the PM for incorporation in the RFP documents.

Keep the PM informed as to current project status on all assigned projects.

Coordinate early in the design process with Drafting to request support and identify level of effort required.

Supporting Engineer (STE): Upon receiving project assignment, coordinate with the LDE to identify scope requirements for discipline of support.

Provide PPS and PSA input to the LDE and their DEM for design assigned man-hour and design schedule requirements related to the support effort. Identify all scope requirements and communicate these requirements to Project Team if this is a multi-discipline assignment.

Perform the function as directed by the LDE and as dictated by the scope of work. Provide a quality design product, meet assigned project scope, meet current approved design schedule, and within the man-hours on the PPS.

Communicate proposed changes in scope, schedule or man-hours to Support DEM and LDE prior to submitting to Lead DEM, PM, and Government for approval.

Provide the necessary backup data or reference material to substantiate recommended changes to proposed design.

Ensure documentation requirements are understood and listed on the Project Summary and Documentation Planning Form, PCMS-DE10. Coordinate with the associated Baseline Manager (BLM) during all phases of the project to validate documentation requirements. If the project is configured, obtain approval by the FSEU CCB prior to design release.

The STE participates in all DR meetings. Provide DR comment dispositions related to Support Scope to the LDE for inclusion in the DR minutes.

Provide input to the Drafter's, if required, for creation of drawings. Provide edited sections of specifications for merging by Lead Engineer for design reviews and final release.

Provide supporting documents within their discipline, i.e. checklists, permits, specifications, calculations, data package, and drawings for complete design package. Submit completed supporting documents to the Lead for checking and signature. Complete documents are released to LDE for merging and collating of complete design package.

Develop technical evaluation bid criteria and provide to the PM for incorporation in the RFP documents.

Coordinate early in the design process with Drafting to request support and identify level of effort required.

Drafter: Upon receiving project assignment, coordinate with the LDE to identify level of effort required for support.

Provide a quality drawing product, meet assigned project scope, meet current approved design schedule, and within the man-hours on the PPS.

Project Manager (PM): BOSS's primary point of contact for the project is to achieve the customer's project goal(s), integrate the company's efforts throughout the Life Cycle, Conception to Project Closeout, and meet cost and schedule constraints. Details and guidance for actions as a PM are explained in ENG-I-PM02.

The Project Manager develops the Project Scoping Agreement (PSA). Holds an internal BOSS pre-design meeting prior to the official PSA meeting. Goal is to provide a completed/signed PSA within three (3) weeks of receipt of the design project. Include within the PSA, the scope of the project, level of design reviews required, design completion schedule, method of implementation, an approximate construction completion date, and any major assumptions, constraints and/or risks affecting the scope and/or schedule. The LDE provides all technical content. Identify on the PSA the determination of requirements for CCB approval prior to final release of the design package. Refer to ENG-I-PM02 for additional guidance.

Send out notifications, chair all PSA and design review meetings, and distribute minutes. Assure all comments are received (obtain "no comment" from reviewers in lieu of no response), all DR comments are dispositioned in writing, and distributed as part of DR meeting minutes. Facilitate proper attendance by required invitees for all PSA and design review meetings.

Coordinate efforts outside of the department and with the Customer. The intent is to relieve the LDE from integration/coordination issues related to customer/SE/SME (Propellants & Life Support) feedback, design contributions etc. However, be sure the LDE/STE is integrated into Technical discussions, and is responsible for technical content of the product.

The PM requests hazardous material sampling/testing when required; Reference section 1.3 for more detail.

Support development of a schedule, and provide schedule recommendations, and constraints to LDE. LDE and DEM's develop, approve and commit to design schedule.

Monitor, track, report and resolve changes in scope, schedule, or budget from the Design Team. DEM's approve these changes prior to approval by the PM, and final approval by the Government.

Schedule/coordinate design reviews, publish and distribute design review invitations, minutes, and distribute appropriate drawings, specifications and data package to key personnel. Assure that design review notices are provided a minimum of five (5) days prior to date of the review. PM shall serve as the Design Review Chairman during the review process. Coordinate all changes to scope, funding and schedule as soon as potential impacts are identified during the review process.

Providing timely and accurate project status updates to IPM Project Management Dashboard (PMD). The PMD provides the Project Manager with a consolidated location to enter and display project data related to his/her individual facility projects. Data includes

project scope, accomplishments, issues and concerns, next milestone, cost and schedule information. The PM updates the PMD weekly for all assigned projects.

Ensure that assigned projects are completed within approved schedule and cost.

Baseline Manager: Baseline Managers are assigned from BOSS Design, Maintenance Engineering, Reliability and Systems Assurance, Configuration Management, and Logistics for each configured baseline. These Baseline Managers are accountable for the BOSS activities that affect their baselines and are responsible to concur in the changes to their baselines.

Engineering Project Control Office (EPC):

Track all work in/out of EPC.

Maintain and update the Integrated Project Management (IPM), , templates, checklists, and reports.

Ensure consistencies in quality of project information input and output.

Create new WONs as requested from Engineering Project Services management.

REFERENCE DOCUMENTS

The following documents are referenced in this procedure:

Document Number	Title
AF Form 813	Request for Environmental Impact Analysis
EAP-F-4800A	BOSS Environmental Requirements For Contracted Projects
EAP-P-4000	National Environmental Policy Act (NEPA) Review Process
EAP-P-4800	Identification of Environmental Requirements for Contracted Projects
ENG-F-DE05	Engineering Work Request
ENG-F-DE11	Construction Cost Estimate Form
ENG-F-DE34	Engineering Review Comments Form
ENG-F-DE36	Project Scope Agreement (PSA)
ENG-F-DE46	Engineering Design Checklist
ENG-F-DE60	Design Engineering Project Content Checklist
ENG-F-PM02	Project Action Tracker
ENG-F-PM05	Lessons Learned/Best Practices
ENG-F-PM12	Technical Evaluation Response Form
ENG-F-PM14	Design Review Meeting Agenda - Minutes
ENG-F-SOW1	Statement of Work Template
ENG-F-SOW2	Statement of Work Template (IDIQ)
ENG-H-0001	BOSS Engineering Services CADD Standards & Drafting/Drawing Conventions. Vol. 1.
ENG-H-0001a	BOSS Engineering Services CADD Standards & Drafting/Drawing Conventions. Vol. 2
ENG-H-0001b	BOSS Engineering Services CADD Standards & Drafting/Drawing Conventions. Vol. 3

Document Number	Title
ENG-I-0013	Surveying And Underground Locators Processes
ENG-F-SWREL	Software Release Form
ENG-I-CS01	CADD Standards Drawing Review Instruction
ENG-I-DE23	Creation of Construction Specifications
ENG-I-MM01	Design Process for Move/Mod Projects
ENG-I-MP01	Site Plan Work Instructions
ENG-I-MP07	Utility Locate/Excavation permits
ENG-I-PM02	Project Management Instruction
ENG-P-0002	Configuration Management of Facilities/Systems/Equipment/Utilities (FSEU)
ENG-P-0018	Requesting Technical Information From Engineering Services
ESD-001(1)	Facility Project POCs (Reviewers & Signers)
ESD-005(1)	Generic Timelines for Project Design and Implementation Efforts
ESD-009(1)	BOE Template for Engineering Hours
KDP-KSC-P-1537	Document Release Authorization (DRA) Process
KNPR 8715.3	KSC Safety Practices Procedural Requirements
KNPR 8830.1	Facilities Asset Management Procedural Requirements
KSC Form 21-608V2	KSC Environmental Checklist
KSC Form 21-68	Document Release Authorization
KSC_FORM_50-191	Engineering Order (OM)
KSC-DF-107	Technical Documentation Style Guide
MSO-P-0002	Outage Coordination Procedure
NPG 8831.2	Facilities Maintenance & Operations Management
PCMS-DE10(2)	Project Summary and Documentation Planning Form
QAL-P-0022	Review and Marking of Technical Data
SHP-P-1926	Contractor Safety
TDC-P-0001	Control of Engineering Documentation

ADDITIONAL RESOURCES

The following documents are not referenced in this procedure, but are an added resource:

Document Number	Title
AFSPCM 91-710	Range Safety User Requirements Manual
EAP-F-3200A	Affirmative Procurement Determination
ENG-F-DE30	Engineering Evaluation
ENG-F-PM01	Project Cost Estimate Form
ENG-F-PM36	Implementation Method Checklist
ENG-I-0016	Construction Estimating Process Guidelines
ENG-P-CM01	Facilities, Systems, Equipment, and Utilities (FSEU) Configuration Control Board Plan
KNPR 8040.1	KSC Configuration Management Procedural Requirements

Document Number	Title
KNPR 8830.1	Facilities Asset Management Procedural Requirements
KSC Form 28-1044	Environmental Health & Environmental Services Support
MSO-P-0001	Launch Planning and Coordination
QMS-P-0002	Control of Records

ACRONYMS

A/E – Architect/Engineer
AMIS – Asbestos Management Information System
A&T – Activation and Turnover
AVO – Avoid Verbal order
BLM – Baseline Manager
BOSS – Base Operations and Spaceport Services
CADD – Computer Aided Design Drawing
CE – Chief Engineer
CID – Configuration Identification Document
CM – Configuration Management
CMDS – Configuration Management Documentation System
CPG – Comprehensive Procurement Guidelines
CS – Construction Services
DE – Design Engineering
DEM – Design Engineering Manager
DR – Design Review
DRA – Design Release Authorization
EA – Environmental Assurance
ECCP – Estimated Construction Contract Price
EDC – Engineering Documentation Center
EDL – Engineering Development Lab, Building M7-0409
EO – Engineering Orders
EPC – Engineering Project Controls
EPR – Engineering Peer Review/Reviews
ESR- Electronic Support Request
ESS – Electronic Security System
FDE – Final Design Estimate
FDEP – Florida Department of Environmental Protection
FFF – Form, Fit, or Function
FP – Facility Projects FSEU – Facility, System, Equipment and Utilities
GIS – Geographic Information System
GPS – Global Positioning Satellite
ITAR/SBU – International Traffic in Arms Regulations/Sensitive But Unclassified
KEDS – KSC Engineering Documentation System
KSSC – Kennedy Complex Control System
LDE – Lead Design Engineer
LDEM – Lead DE Manager
MCs - Major Componants

MESC - Medical and Environmental Services Contractor
NASA – National Aeronautics and Space Administration
NAVD – North American Vertical Datum
NFP – Non-Facility Projects
NOI – Notice of Intent
NoIT – Notice of Impending Turnover
NOT – Notice of Termination
NPDES – National Pollutant Discharge Elimination System
NSE - NASA System Engineer
O&M – Operations & Maintenance
OMD – Operations and Maintenance Documentation
OMI – Operations & Maintenance Instruction
P&E – Planning & Estimating
PDF – Portable Document Format
PM – Project Manager
PPE – Personal Protection Equipment
PPS – Project Planning Sheet
PSA – Project Scope Agreement
PV/S – Pressure Vessels and Systems
QAR – Quality Assurance Review
RA – Risk Assessment
REC – Record of Environmental Consideration
RF – Radio Frequency
RFI – Request for Information
ROM – Rough Order of Magnitude
S&H – Safety & Health
SIES – Supervision, Inspection and Engineering Services
SE – System Engineer
SME – System Maintenance Engineer (Propellants & Life Support and NASA only)
SR – Support Requests
STE – Supporting Engineer
SWPPP – Storm Water Pollution Prevention Plan
TBC – Total Building Commissioning
TE – Technical Evaluations
WON – Work Order Number

DEFINITIONS

Baseline: A numbering system used to identify Facility, System, Equipment and Utilities (FSEU) by type and location.

Configuration Baseline Documentation: The drawings, specifications, and associated lists that describe the established functional and physical configuration of configured FSEU. Configuration baseline documentation may also include other types of Operations and Maintenance Documentation (OMD) described in TDC-P-0001, Control of Engineering Documentation.

Configuration Control: The systematic process for identifying, evaluating, coordinating, documenting and processing changes to a configured item after its baseline documentation has been formally established. Any facility/system/equipment/software or any of its discrete portions that satisfies an end-use function may be designated to be under configuration control.

Configuration Control Board (CCB): A group of technical, administrative project personnel, or managers who are responsible for reviewing and assessing engineering changes to the configured item.

Engineering Documentation Center (EDC): Provides a central repository for engineering documentation. It includes both hardcopy and electronic media.

Field Change: A real-time change affecting form, fit, and/or function of a configured system -- specifically, an anomaly that needs to be corrected immediately in the field. All field changes require form TDC-F-TD02 and require CCB approval.

Engineering Peer Review (EPR): The EPR is a focused technical review, which verifies the design product meets the customer requirements and meets the appropriate technical requirements.

Facilities/Systems/Equipment/Utilities (FSEU): Includes facilities, systems (in or outside a facility), utility systems, or the individual equipment or components in the Maintenance and Operations and Propellants & Life Support divisions.

Graded Approach/Levels of Design: The Graded Approach is the process by which the levels of engineering analysis, documentation, approval and review are based on facility/system specific factors. Graded approach is used to determine the rigor with which engineering requirements are applied. When applying the graded approach, consideration is given to the potential impact that the Form, Fit, or Function (FFF) has on the safety of a Facility, System, Equipment and Utilities (FSEU).

Life Cycle: A generic term relating to the entire period of conception, definition, builds distribution, operation, and disposal of a product.

Library Research Link (Knovel): The Space Center sponsors a library web search program from Knovel that allows engineers to obtain, in most cases, access to a multidisciplinary set of reference books and documents. The link is KNOVEL.

Maintained Document: A document, typically directly related to the configuration of a system, which is revised/updated to coincide with any changes with the system. This may relate to a single document, such as a drawing, or a document suite such as SCA/SAA/OMRSD/SPA/DWG. All other documents are non-maintained.

NASA TECHNICAL STANDARDS PROGRAM (NTSP): This is the site where all NASA and KSC technical documents can be accessed. The site requires a login so all first time users have to register for access permission. The link is NTSP LINK.

OMEU: OMEU is a matrix report listing facilities, systems, equipment, and utilities (FSEU) at Kennedy Space Center, Cape Canaveral Space Force Station, and selected sites at Patrick Space Force Base and the Annexes. Operations, Maintenance, Engineering, and User (OMEU) responsibilities are listed for each FSEU line item per PWS 1.7-8. The

OMEU report is available on the BOSS Home Page. Note specific OMEU designations as follows:

- Operation – Organization responsible for operation of the FSEU.
- Maintenance – Organization responsible for maintenance of the FSEU.
- Engineering – Organization responsible for the engineering and design effort required to maintain a design so that it fulfills its original design intent, and to assure that new designs/modifications are compatible with the intended operational use.
- User – Organization which physically uses the FSEU (if known) typically the owning government agency.

OMEU process is outlined in the OMEU PROCESS CHART.

Operations and Maintenance Documentation (OMD): The documentation forming the configuration baseline documentation. OMD may include drawings, instructions, specifications, SCAs and other Risk/Hazard Analysis Packages, SPAs, PV/S and DOT compliance reports, OMIs, and Job Plans.

Program Model Number (PMN): A unique alpha-numeric number used to identify FSEU by category.

Project: An activity, designated by a program, characterized as having defined goals, products, objectives, requirements, a Life-Cycle Cost (LCC), a beginning, and an end.

Project Summary and Documentation Planning Form (ENG-F-DE-10): This form is generated from the Project and Configuration Management System (PCMS) formerly known as WON Tracking database and identifies all documentation requirements levied upon the project. The DE10 is initiated by the Configuration Management Office with support from the Design Engineer and System Maintenance Engineer.

Record Drawings: Official engineering documentation released to the Engineering Documentation Center (EDC) or turned over to BOSS as best or only available documents or submittals, reflecting as-built conditions. When no documentation is available, configuration of the as-built condition is to be field verified and documented by BOSS as required.

Note

Record drawings and as-built conditions are accepted "as is" until modifications or field corrections are made by BOSS. However, field verifies documentation before being relied upon for new designs.

Reference Document: When used in a drawing, specification, or instruction, this term refers to documents that provide contractual and/or regulatory guidelines to BOSS and Team Member Subcontractor operations. Reference documents may be in the form of OSHA or EPA regulations, NASA KMI, or Manufacturer's Technical Manuals, etc.

Request for Information (RFI): The RFI is a contract document (outside subcontractors – not for internal use) used in the construction industry in cases where it is necessary to confirm the interpretation of a detail, specification, or note on the construction drawings

or to secure a documented directive or clarification to continue work. For further information, refer to procedure ENG-P-0018.

Site Design Authority (SDA): The SDA has the responsibility to ensure that all the technical requirements of the BOSS are being met and that the process and products meet NASA requirements and standards, Federal, State, and Local laws and industry standards. This individual is the Technical Authority for the company and therefore has authority over all personnel acquiring or modifying FSEU when acting as the SDA.

Note

ENG-P-0002 defines relationship of the SDA to the Information Management organization having authority for associated software systems.

SPECSINTACT: The freeware program provided and maintained by NASA for the creation of government oriented construction specifications. Creation of Construction Specifications (ENG-I-DE23) establishes guidance on the creation of construction specifications using the NASA “SpecsIntact” software and submitting the proper documentation/files to Project Control.

Verification: The determination that an item meets design requirements. The design element/project is responsible for verifying that the as-built configuration satisfies requirements and design documentation (closed-loop verification). Implementation of configuration baseline is verified by the implementing element or project and non-conformances is identified and dispositioned.

Validation: The determination that an item meets its intended purpose in its operating environment. For models/analysis tools, design environments and simulations, validation is the determination that the item accurately reflects the subject being modeled (i.e., it is a valid model or database). This may include acceptance testing.

REVISION RECORD

The following revisions have been applied to this document:

Revision Number	Change Description	Date
0	Initial Release	09/21/09
1	Revised in its Entirety	10/15/10
2	Revised	07/20/11
3	Minor revisions: Update Records Table. No Formal Review Required per QPO.	08/18/11
4	Minor revisions. Added reference to ENG-F-SOW1. Update Records Table. No Formal Review Required per QPO	10/26/11
5	Revised in its Entirety	12/19/11
6	Minor revisions. Added OMD Guidelines; Form ENG-F-DE60 & DE61. Updated Section 4.7. Deleted Section	02/20/13

	4.7.2 & 4.8.6. Updated Records Table, Reference Documents and Acronyms.	
7	Minor revision to add reference to ENG-F-SOW2 (See 2.1.3.) Updated Reference & Record Tables.	05/02/13
8	Minor revision to add reference to ENG-F-PM14; Revised Hazardous Material Sampling/Testing section; Replace SSE/SME with SE where applicable; other minor revisions.	10/31/13
9	Minor revision to add reference to form WCC-F-ROM1, Project Rough Order of Magnitude (ROM) and Update Records Table	4/30/15
10	Added ENG-F-SWREL – software release form to pages 30 and 40.	10/27/16
11	Update in progress after section 3.1	03/24/20
12	Partial revisions throughout. More revisions to follow.	06/02/21
13	Added Major Component (MCs) and minor description additions	02/10/22
14	Engineering review. Minor administrative edits	02/20/24

DOCUMENT APPROVALS

