Comprehensive Design Review Guidelines

ME481 Spring 2021

Purpose
Identical to the Preliminary Design Review, “A design review is a retrospective study of the design up to that point in time. It provides a systematic method for identifying problems with the design, aids in determining possible courses of action, and initiates action to correct the problem areas.” Design reviews are a critical part of every design process. They help avoid “group think” and identify problems in the concept or analysis. Design reviews should occur at multiple stages throughout the design process; otherwise, if left to the end of the project, changes, errors, or new brilliant ideas will be expensive and difficult to implement. Typically, design reviews occur at each major stage of the design—before the design team can move into the next phase: project specifications and metrics defined, strategy selected, concept and modules selected, detailed design finished and ready for initial fabrication, and possibly more depending on the scope of the project.

Actions in the Critical Design phase include completing the detailed systems and component design; developing plans for fabrication and assembly of the system; completing component, subsystem, and system testing plans (including measurements, data analytics, etc.).

The Critical Design Review (CDR), presented at the end of this phase, is a formal technical review of the detailed design, completed prior to the release of firm design data packages for production. The design is essentially "frozen" at this point. Evaluators scrutinize the proposed configuration in terms of the adequacy and producibility of the basic design approach that has been selected for the system or subsystem/component. Like the PDR, CDRs can be held for individual critical subsystems, systems, components and software, as well as the full system. We will not hold individual CDRs in class, but you should. We will hold a CDR for the full system; the results of this CDR describe the final system/subsystem configuration baseline prior to entering into production. Technically, fabrication of components, subsystems, etc., should not begin until after the CDR, although prototyping is encouraged.

The CDR is the last in a series of progressive evaluation efforts, reflecting design and development from a historical perspective and showing the growth and maturity in the design as the engineering program evolved. However, it should not be chronological. Your first objective is to describe and defend the current design. The historical perspective provides background to justify your choices. A typical CDR involves detailed scrutinization of:

- Hardware
  - A final design synthesis of the Development Specification requirements.
  - Trade studies or design studies results.

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• System architecture and operations concept.
• Operational flowcharts and operations modes.
• Production functional flows, requirements allocations, and schematic diagrams.
• Equipment layout drawings.
• Any proprietary or restricted design/process/components or information.
• Thermal design aspects and environmental controls.
• Power distribution and grounding design aspects. (as appropriate)
• Final production mechanical and packaging design considerations.
• Safety engineering considerations.
• Security engineering considerations.
• Survivability and vulnerability considerations.
• Final production lists of materials, parts, and processes.
• Reliability, Availability, and Maintainability.
• Weight data.
• Power data.
• Test data.
• Interface requirements and derived requirements from the Development Specification and Interface Control Document (ICD).
• Production schedule(s).
• Mock-ups, prototypes.
• Producibility and manufacturing considerations. These include: materials, tooling, test equipment, processes, facilities, single source, sole source, diminishing source.
• Transportation, packaging, and handling considerations.
• Human Engineering considerations.
• Descriptions and characteristics of commercially available equipment and any options, special features or limitations.
• Existing documentation available (COTS manuals or drawings).
• Description of firmware.
• Corrosion prevention and control considerations.
• Status of quality issues and findings to date.
• Support equipment requirements.

• Software
  • Detailed flows, showing the requirements allocated from the Software Requirements Specification and Interface Requirements Specifications to the top level CSCIs.
  • Descriptions of storage allocations for each CSCI.
  • Detailed description of the vehicle or apparatus control system, including: executive control, system operations, start/recovery from malfunctions.
  • Detailed flowcharts of all software (standard nomenclature)
  • Security and software configuration management (CM) procedures.
You are expected to produce an abbreviated CDR focused on the most important items for your project.

ME 481 CDR Objectives

• Provide context
  o a concise re-introduction to your design problem, including the primary motivation for the project, the key technical challenges, and any existing full/partial solutions (prior art).
  o Provide the most up-to-date versions of your overall goal statement and stakeholder objectives, as well as the relative importance and rationale behind each objective.
  o Provide the most up-to-date versions of all system-level project requirements, with the validation methodology and rationale for each one explained in detail.

• Clearly describe the overall system-level design of your proposed solution, including a completed CAD model of your overall assembly.

• Clearly describe the mode of operation of your proposed solution, including interactions with all key stakeholders.

• Describe the following aspects of each subsystem of your proposed solution in detail:
  o Project requirements, both system-level and subsystem-level.
  o Overall design, including all key components (both purchased and team-manufactured).
  o All design analysis, justifying your belief that each subsystem will meet all of its requirements.
    ▪ Analyses, predictions, trade-off studies, test and evaluation results, and related design documentation (reliability, maintainability, availability, human factors, safety, test reports, etc.)
  o FMEA and Risk Analysis, with associated mitigation strategies.
  o Potential outstanding concerns and issues.

• Provide an updated management strategy for completing your proposed solution, including:
  o Descriptions of roles/responsibilities assumed for this portion of the project and proposed for the next.
  o A complete budget and bill of materials, with all funding sources described.
  o An updated WBS and project timeline.
• Include complete, detailed documentation of your design:
  o Engineering drawings for all components that must be manufactured for your prototype.
  o Manufacturing plans for every component you are manufacturing yourselves and/or modifying from stock items.
  o Source code for any software (if applicable).
  o A bill of materials (BOM) for every purchased material/component.

Written Report
Throughout the report, do not just make assertions—rather, back up the assertions with evidence. Use first order mathematical and physics estimates as well as references from journal articles, books, or other sources that are well respected

Title Page [1 page maximum]
• First line: “ME 481 2021 Spring – Critical Design Review”
• Second line: Your own descriptive title/team name
• Logo (project, team, or sponsor)
• Names of all team members and their team role titles
• Final line: “Instructor: A Zachary Trimble”

Executive Summary2 [1 page maximum]
The Executive Summary should give the reader all the important information and findings of the document without having to read any further. Summarize both the project and the contents of the report. In other words, you must capture the reader’s interest; summarize the purpose, importance and impact of the project; and inform the reader what they can expect to learn about the project from this particular report. Because of its content and location this section is the most widely read section of the document. For that reason, the section should be well written and carefully proofread. First impressions matter. Incorporate into the executive summary the project mission statement in italics.
The mission statement should be a smooth part of your executive summary and not an after-thought or add on. For the preliminary design review it is particularly important to convey that you have clearly thought through every aspect of your entire project and to leave your reader with the confidence that you will be able to satisfy your stakeholders’ demands.

Table of Contents2
List of Figures and Tables2 (should show page numbers)
Acronyms and Abbreviations2
Technical Report Body3 [60 pages maximum]
Address the report objectives. Below is a skeletal suggested outline (i.e. you should add project appropriate sub-sections), but you have freedom to address the objectives in whatever

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2 Should be paginated with “i, ii, iii, iv,…”
3 Should be paginated with “1,2, 3, …”
way is best for your project.

1. **Introduction**
   All reports should have an introduction. One purpose of the introduction is to introduce the problem and justify the significance of the project. Do a short synopsis of your problem statement (discussing purpose of the project, relevance, need for it, objectives, top level requirements, top level constraints, etc.), i.e., provide motivation for the work presented in the report. and relevant background information placing it in context with previous efforts and state-of-the-art. Provide an overview of related work and summary of design considerations and problems that had to be overcome. The introduction should include at least five references to related papers and books.

The introduction should also introduce the format and layout of the remainder of the report. In particular, the main report presents the detailed description of the system and results of your analyses, etc., while the supporting methodologies, equations, detailed analyses, etc., that were used to calculate your results are contained in the appendices. Also describe the other items that can be found in the appendices (detailed financial budget, the full list of requirements, etc.).

2. **Technical Details**
   This section should include a detailed description of the detailed design of your system to demonstrate that it is ready to go into production. You should summarize your strategies and concepts, defending your decisions or expounding on the benefits of your design over the alternatives. Discussion of all design considerations (cost, weight, function, performance, schedule, risk, etc.) Summary of engineering analyses—details in appendices. Description of any bench-level experiments or prototypes that were used to verify your design. Discussion of manufacturing—complete engineering drawings in the appendices. Discussion of original contributions. Discussion of performance budgets and risks (as outlined). A suggested format is provided below. Use the format to form your arguments and standardize the reports, but since the class projects span a large range of types, the format can be modified slightly as appropriate to your project.

   2.1. **Proposed Solution**
   No mystery stories explain your solution immediately and how it addresses the objectives. Describe the overall structure of your proposed solution in detail, including a list of all subsystems. Include CAD-modeled figures of the overall external isometric view of the complete system and exploded view of identifying each subsystem. (I.e. perfected system architecture). Use the design process history if necessary to justify but avoid an anthology.

   Describe, and illustrate with CAD-modeled figures, the complete sequence of
events involved in the function of your proposed solution. (I.e. perfected concept of operations and functional flow diagrams).

2.2. Subsystem Descriptions
Describe each subsystem.

- Requirements
Aside from restating any top system-level project requirements addressed by the subsystem, include any top project requirements dictated by other subsystems. Include a full table in the appendices. Note any changes since the Preliminary Design Review.

- Design
Describe the implementation of the subsystem, including one or more CAD-modeled figures that clearly illustrate all key components. Describe which component(s) will be manufactured by/for the team as well as any that will be purchased and/or modified from “off-the-shelf” products. Note any changes since the Preliminary Design Review. Direct your audience to find the full versions of the detailed engineering drawings, source code, bill of materials, etc. in the appendices.

- Analysis
Include all engineering analysis for the subsystem. This may include theoretical mathematical models (this should go beyond simple 1-D analysis at this point), empirical testing of mockups, and/or results from purchased component datasheets (i.e., “shopping” analysis). Your goal here is to convince your audience that the subsystem will meet all of its associated requirements.

- Validation and testing
Using the language of your requirements, describe how you will prove that the components and then the subsystem meets all of its project requirements once you fabricate it. This includes the experimental method, the data the will be collected and the projected data reduction techniques. If the subsystem will be validated as part of an experiment testing many subsystems/requirements at once, you only need to describe the experiment in detail once (i.e., don’t be redundant) and then refer to the test for subsequent systems. One of you biggest values as an engineer is to provided predictive models, this section should outline how you will comprehensively validate your analysis models as well as the components and subsystems.

- Risk
Describe the results of a FMEA and Risk Analysis (if relevant) for the subsystem. For the remaining highest-impact failure modes and use hazards, describe any design revisions you’ve made to mitigate their likelihood and/or
consequences. Note any changes since the Preliminary Design Review. Do not be fluffy in this section. Only describe valid and legitimate design risks.

3. Project Management/Proposed Approach
   How is your team set up for success? Do you have the expertise you need? What are your time and money requirements and constraints? What are the general tasks and risks? What are the key milestones that must be reached for your project (i.e. not just class milestones)?

3.1. Organizational Structure
   Restate your primary team structure, and describe how the roles and responsibilities of each team member may evolve in order to address the implementation of your proposed solution. Will individuals be assigned tasks based upon special skills (e.g., CAD modeling, numerical analysis, machining/assembly) or by subsystem? Include your rationale for these decisions.

3.2. Project Timeline/Schedule
   Update your milestone timeline and what it means to achieve each milestone. Update your time budget. I.e. are you on schedule? Provide a schedule to achieve the aforementioned tasks and identify the critical path. Include detailed updated versions of both your work breakdown structure and timeline in the appendices and reference them as necessary. Don’t forget to include shipping times.

3.3. Budget
   Provide an overview of your updated budget, as well as justifying each of your top three to five expenditures. Describe any sources of funding/supplies and plans to acquire further resources. Give a full overview here with tables and charts and direct your audience to find the full versions of the budget and bill of materials in the appendices.

3.4. Potential Challenges/Risks
   Identify and critical project management level risks.

4. Conclusion
   It is important to provide a real conclusion. This is a design review. It should be accompanied with an authorization to proceed. So provide a conclusion. Have you met all the necessary gates to pass the review?

5. References (Start on a fresh page. Does not count against page limit)

Appendices (Start each on a fresh page. Does not count against page limit)
Include any information that would not fit within your main document. At minimum include

1. Objectives and Requirements
   Complete table(s) of all stakeholder objectives and requirements both basic and derived in table format with a useful traceability and status tracking methodology

2. Schedule
   Provide your full Gantt chart.

3. Manufacturing Plans
   Full manufacturing and procurement plans including engineering drawings for any components that must be custom manufactured.

4. Full Budget
Formatting Information

- Use single-spaced 12-point font for all body text. Headings may be larger if desired.
- Use 1 in. margins on all pages.
- Number all pages after the Table of Contents at the bottom footer of each page. Use roman numerals for the pre-content.
- Figures and tables must be centered in the middle of the page (i.e., no text-wrapping) and have a unique number and caption.
- Use ASME (or other relevant) citation and reference style.

Evaluation

All items are graded on a 10-point scale (see the RIP Website). The objectives are assessed on the information in the body of the report and the information in the appendices and on the proper balance between what information is in the report and what is referred to in the appendices.

<table>
<thead>
<tr>
<th>Objective or Element</th>
<th>Weighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Executive Summary</td>
<td>0.1</td>
</tr>
<tr>
<td>Introduction/Overview</td>
<td>0.05</td>
</tr>
<tr>
<td>Proposed Solution</td>
<td>0.1</td>
</tr>
<tr>
<td>Subsystem Details (including appendices)</td>
<td>0.3</td>
</tr>
<tr>
<td>Project Management (including appendices)</td>
<td>0.25</td>
</tr>
<tr>
<td>Conclusion</td>
<td>0.1</td>
</tr>
<tr>
<td>Quality, Conciseness, Effectiveness</td>
<td>0.1</td>
</tr>
</tbody>
</table>

Oral Presentation

**Audience:** Your stake holders and the ME 481 course (I.e Technical)

**Format:** Formal (Questions at the end)

**Location:** Zoom – you must have a camera for presenting. One team member will be allowed to share screen for slide presentations.

**Date:** 3 & 5 April

**Time:** 65 minutes presentation plus 15 min questions

**Participation:** All team members must present

**Attendance:** All students must attend all presentations. You are expected to be an active peer reviewer and ask meaningful questions and provide meaningful feedback.

**Dress Code:** Business professional (Hawaiian)

**Evaluation:** Based on the presentation evaluation criteria posted to the course website.

- **If Your Project Has Sponsor(s):** You must also invite your sponsor(s) to your oral presentation and make every effort to schedule your presentation so that they can attend. If your sponsor(s) are unable to attend, it is your responsibility to arrange for a teleconference or recording.
- All slides (except Title Slide) must show the slide number and the total number of slides in the main presentation (not including Backup Slides) e.g. 14/37
- The name of the presenter should be on the first slide of a contiguous set of slides that the student is presenting. The student’s initials should be on each other section.
• **NOTE:** The list of topics in the purpose section is for a thorough CDR of a major system with a multi-year development schedule and dozens or hundreds of engineers. A CDR presentation usually takes several hours or days, and in fact, as mentioned in the introduction, the major elements (e.g., operations, ground segment, software, individual subsystems usually have their own CDRs before the combined project CDR). For example, the Clementine Project CDR took three days, the CDR for Honeywell’s Commercial Satellite Ground Network System (DataLynx) took 2 days, and the HawaiiSat-1 CDR took a full day. My expectations are not as lofty, and I am looking for just the essential items. Time is limited, use the ME 481 objectives as a general guide. You are expected to exercise good engineering judgement and understand what information is most critical to present for your project. You will NOT have time to get through 100’s of slides.

**Submission Information**

• **Deliverables:** *Due at 1700 on Friday, April 7*
  - Digital copy of your report
    - File naming convention:
      “me481_2021s_cdrReport_abbreviatedTeamName.pdf”
  - Digital copy of your slides
    - File naming convention:
      “me481_2021s_cdrPresentation_abbreviatedTeamName.ppt”

• **Submission:**
  - Both electronic deliverables must be submitted as attachments to a single email written by the project manager, addressed to the instructor, and having the subject line “ME481 2021s: Critical Design Review – Team name”
  - **If Your Project Has Sponsor(s):** A second email written by the project manager, addressed to the sponsor(s) and cc’d to the instructor, and having the subject line “UH Senior Design Project – Critical Design Review Documents” must be sent with the deliverables attached. All deliverables sent to sponsor(s) must be in Adobe PDF (.pdf) format.
Appendix A – Past Presentation Information
As requested by previous cohorts, I tried to provide a more descriptive suggested outline this year. However, I still think it is important for you to be familiar with the vocabulary. Thus, below is the example presentation outline provided in the past.

1) **Project Mission System Level Presentation should contain (as appropriate):**
   - Mission statement, objectives, success criteria
   - Mission Operational System Architecture (project and mission overview)
   - Ops concept (using System Architecture or dedicated slide)
   - Team Organization
   [NOTE: Section 5, Project Management can optionally be presented here]

2) **Project Systems Engineering Presentation should contain (as appropriate):**
   - Proposed solution and system overview (what are you building?)
   - Overall System Functional Flow Block Diagram (FFBD)
   - System Level changes since PDR baseline design (and rationale) incl. budgets
   - Vehicle/apparatus key characteristics
   - Final Configuration of Vehicle/Apparatus (multiviews, external & internal)
   - Exploded view of vehicle/apparatus with identification of major components
   - Accessibility, Availability, Maintainability – *discuss as applicable*
   - Safety Engineering
   - Detailed System Level Integration Plan including assembly sequence
   - Detailed System Level Testing plan (including procedures and success criteria)
   - Weight & Volume Budgets (allocated vs actual)
   - Power Budget and Power Profile (system-level)
   - Configuration and Change Management *include process and current examples*
   - Results of FMECA and Reliability Analysis
   - Remaining Issues and Concerns

3) **Subsystem Level Presentations should contain (as appropriate):**
   - Subsystem Team Roles & Responsibilities
   - Functional (Flow) Block Diagram with external interfaces – *show subsystem as an integrated domain and context in System FFBD*
   - Changes since PDR baseline design (and rationale) incl. budgets
   - Location of subsystem in vehicle/apparatus (*ghost view if applicable*)
   - Detailed description (including all schematics, list of components & parts, etc.)
   - Production functional flows and producibility and manufacturing considerations. *These may include: materials, tooling, test equipment, processes, facilities, single source, and sole source*
   - Assembly and Integration Plan (subsystem-level)
   - Software flowcharts (if applicable)
   - Results of analyses (Performance, etc)
   - Subsystem Weight & Volume Budgets (allocated vs actual)
   - Subsystem Power Budget (allocated vs actual)
   - Subsystem power profile (during nominal and contingency operations)
   - Risk Analysis (include identified subsystem-level risks and mitigations)
   - Results of FMECA and Reliability Analysis
- Detailed Testing Plan (including procedures and success criteria)
- Subsystem WBS with numbering consistent with system WBS
- Subsystem Schedule using WBS and Gantt Chart showing current progress
- Requirements vs. Implementation Table (show status using red, yellow, green)
- Remaining Issues and Concerns

4) **Ground Segment and Operations should contain (as appropriate):**
   - Ground Segment Architecture
   - Team Roles & Responsibilities
   - System Level changes since PDR baseline design (and rationale) incl. budgets
   - Functional (Flow) Block Diagram with external interfaces
     (show subsystem as an integrated domain)
   - Operations logic flow chart and operational states (if applicable)
   - Detailed description (including all schematics, list of components & parts, etc.)
   - Assembly and Subsystem Integration Plan
   - Software flowcharts (if applicable)
   - Results of Analyses (Performance, etc.)
   - Risk Analysis (include identified subsystem-level risks and mitigations)
   - Results of FMECA and Reliability Analysis
   - Site Selection (if applicable)
   - Detailed Testing Plan (including procedures and success criteria)
   - Subsystem WBS
   - Subsystem Schedule using WBS and Gantt Chart showing current progress
   - Requirements vs Implementation Table (show status using red, yellow, green)
   - Remaining Issues and Concerns

5) **Project Management Presentation should contain (as appropriate):**
   - System WBS with numbering
   - System-level Schedule (Gantt Chart with WBS) showing progress to date
   - Hardware Acquisition Status/Plan (long lead items)
   - Risks Management (include identified system-level risks and both proactive and reactive mitigations)- Financial Budget
   - Documentation List (include status using color codes)
   - Requirements vs. Implementation Table (show status using red, yellow, green)
   - Remaining Issues and Concerns

[NOTE: This section can optionally be presented after Section 1]

6) **Conclusion**

7) **Backup Slides**
   - Problem Statement and context
   - Full SSD (System Specification Document) including all requirements (identify if functional or operational) and constraints for entire project – include proper numbering and traceability
   - Conceptual designs and trade studies (including MMDs and Pugh Matrices)
   - Equipment layout drawings
   - Analyses
   - FMECA detailed results and tables with CIL (Critical Items List)
- Change log (CRs and DRs)
- Action Item List
- Other material that you did not have room for in the main presentation
Appendix B – Past Report Outline Information
As requested by previous cohorts, I tried to provide a more descriptive suggested outline this year. However, I still think it is important for you to be familiar with the vocabulary. Thus, below is the example report outline provided in the past.

2 Technical Overview [90 pages maximum]
This section should include a detailed description of the detailed design of your system to demonstrate that it is ready to go into production. All the information given in your CDR presentation should be included, either in the main report of the appendices. You should summarize your strategies and concepts, defending your decisions or expounding on the benefits of your design over the alternatives. Discussion of all design considerations (cost, weight, function, performance, schedule, risk, etc.) Summary of engineering analyses—details in appendices. Description of any bench-level experiments or prototypes that were used to verify your design. Discussion of manufacturing—complete engineering drawings in the appendices. Discussion of original contributions. Discussion of performance budgets and risks (as outlined). Use the format below to form your arguments and standardize the reports. Since the objects being developed in the class projects span a large range of types, the format can be modified slightly as appropriate to your project, but the majority of it should be the same for all.

2.1 Objectives and Requirements
- Provide:
  1. Mission Statement (repeated in Executive Summary)
  2. Objectives and Success Criteria
     Refer to the full set of requirements contained in Appendix A.

2.2 Conceptual and Basic Designs
- Summarize major system-level (vehicle/apparatus) trade studies and design candidates
- Make an argument to prove how your selected design was the best among all concepts – Discuss how your current design has changed and evolved from your baseline design
- Summary of engineering analyses (details in appendices): Stress, fatigue, kinematic, dynamic, thermal, economic; Description of any bench level experiments performed

2.3 Detailed Design
2.3.1 Top-Level System
- Discuss your current design including:
  2.3.1.1 System architecture – show project elements with reference to assembly and shop drawings
  …2 Operations concept – explain in detail nominal operation
  …3 Top-level Functional Flow Block Diagram – identify connecting arrows
  …4 Overall configuration – detailed description with isometric views, external, internal, and exploded views
  …5 Performance analyses – prove it will meet requirements
  …6 FMECA – show summary including failure modes, especially critical failures, and include failure/reliability tree(s)
  …7 Safety Engineering – identify potential hazards and mitigations
…8 Human Factors Engineering – describe how the design considers ease of human operation or interaction (if applicable)
…9 Fabrication Plan – show production flow and fabrication considerations
…10 Integration & Test Plan – show assembly sequence and detailed test plans including procedures and success criteria
…11 Accessibility, Availability, Maintainability – discuss as applicable
…12 Weight & Volume Budgets (total system) – show allocations and actual values
…13 Power Budget and Power Profile (total system) – ditto

2.3.2 Subsystems (including Ground Segment)
2.3.2.1 Subsystem A etc. (follow same numbering scheme as in 2.3.1)
- Subsystem Team Roles & Responsibilities
- Changes in subsystem design since PDR with rationale
- Functional (Flow) Block Diagram with External Interfaces
- Subsystem Weight & Volume Budgets (if applicable) – show allocations and actual values
- Subsystem Power Budget (if applicable) – show allocations and actual values
- Description – include detailed circuit and mechanical layout schematics, list of components & parts, component layout, wiring layout, software flowcharts, etc.
- Results of Technical Analyses – performance, FEA, thermal, etc.
- Risk Analysis (include identified subsystem-level risks and mitigations)
- Subsystem FMECA – show summary including failure modes, especially critical failures, and include failure/reliability tree(s)
- Detailed Test Plan – include test procedures and success criteria
- Subsystem WBS
- Subsystem Schedule using combined WBS and Gantt Chart – remember numbering of WBS items that match System WBS and have tasks at lowest level - show progress of tasks in the Gantt Chart
- Requirements vs. Implementation – table that shows most important subsystem-level requirements and their current status at CDR (show status using red, yellow, green)
- Remaining Issues and Concerns

3 Management and Cost Overview [15 pages maximum] Use same numbering scheme as in other sections
- Include organizational chart and indicate each team member’s tasks
- Project WBS – remember numbering of WBS items and have tasks at lowest level
- System-level Schedule (Gantt Chart with numbered WBS) – show progress to date
- Hardware Acquisition Status/Plan (long lead items)
- Risks Management – provide risks list with proactive & reactive mitigations
- Configuration and Change Management – describe process and procedures
- Financial Budget
- Documentation List
- Requirements vs Implementation – table that shows most important system-level requirements and their current status at CDR (show status using red, yellow, green)
- Remaining Issues and Concerns

4 Conclusion [1 page maximum]
- A concise recap of the most important facts and information
References*
- Properly cite all references used in the text (use ASME style guide)
- These should be primarily scholarly articles: Journal and conference papers, books, etc.
- Internet references are strongly discouraged because they usually are not reliable.

Appendices*[NOTE that the appendices have a different page numbering]*
A – System Specifications Document
- Using a table, list the mission statement, objectives, top-level and derived programmatic and
technical requirements and constraints including assigned object number, permanent
identification number, description (use “shall”), priority (Mandatory, Desired, Luxury),
verifiability & method (A[alysis], I[nspection], S[imulation], T[est]), and parent and children
requirements. You should also show using the red/yellow/green color the status of the
implementation of the requirement (red=not implemented, yellow=in work or partially
implemented, green=fully implemented).
B – Financial Budget
- Create a detailed and itemized budget with subtotals and totals. Include funding sources.
C – Project Management and Systems Engineering
- Include Action Item (AI) List, Meeting Minutes, Change Request (CR/DR) List, Meeting
Minutes, and other items used in PM. (Note: Some of these items can be in a separate appendix if
too large)

Note: Other appendices, such as trade studies, supporting algorithms and analyses, engineering
drawings, copies of Work Package Descriptions, etc., should be added as needed.