Format for the Operational Readiness Review (ORR) Report

At an ORR the focus is on Phase D results, i.e. System Assembly, Integration and Test. The ORR report is built from your CDR report from last semester. You will edit your CDR report by updating the old material and adding new material. This mostly includes:

- *Updating of mechanical drawings, bill of materials, interfaces, text and analysis as necessary*
- *Adding your test results of the subsystems and the system, and instructions on safe operation.*

You are to 1) make 3 hardcopies of this report for the industrial sponsor and your instructor, 2) load the report onto your webpage, 3) deliver to Dr. Beale your design notebook, 4) include your CODs + deliverables, clipped to one of your reports for Dr. Beale. Hardcopying costs will be covered by the sponsor in most cases, so see Dr. Beale or the TA when ready to make hardcopy reports.

From the Syllabus: Final MPCOD Evaluation with Final Report, Webpage, and Design Notebook are 35% of your course grade. 20% of your grade is from the CODs plus deliverables.

This semester has been spent on Phase D, which, from the course website, involves:

Phase D - System Assembly, Integration, Test and Launch (SAITL)

Purpose: To assemble parts and components to create the subsystems, integrate subsystems to make the entire system, to test the subsystems and system to be able to meet requirements, and finally to launch the system.

Activities: The Systems Engineer is very involved in evaluating and qualifying the system based on verification and validation test procedures for components, subsystems and system. Perform environmental testing. Resolve any discrepancy of performance with requirements. Prepare an operator's manual and, if needed, include maintenance, storage and shipping procedures. Demonstrate the system at a Readiness Review (RR) or Operational Readiness Review (ORR).

Systems Engineer's Report: Report on the test results, including ability of the system to meet requirements, mission and functional performance. If there are any changes in the 11 SE functions and the baseline design, remember to update the documentation to track the changes.

Below is the exact format for your report. The changes and additions to the CDR report in red.

TITLE PAGE – Include a descriptive project title with "Operational Readiness Review" in the title, name of "corporation", members, semester, date, course ("MECH4250"), instructor, corporate sponsor.

SUMMARY or **ABSTRACT** (1 page of text, about 200 words). This is a short summary of what the problem is, what you have accomplished and your conclusions. It gives the reader a clue of what are the most important contributions of the work. Updated from CDR, with emphasis on the test results on both the subsystems and system.

TABLE OF CONTENTS

INTRODUCTION (should be written by Project Manager)
Introduce the assignment, state and identify the design problem. Discuss previous work. In one or

two added paragraphs, discuss comments of the sponsor from CDR, and your response/actions taken and documented in the rest of the report.

MAIN BODY

SYSTEMS ENGINEERING (by Systems Engineering team members)

1. Mission Objective – present a clear statement of the mission objective that all stakeholders have agreed upon and accepted. Hopefully this remains the same from the PDR/CDR. Also attach MPCOD here (which, in a sense, is your mission objective for this semester)
2. Architectural Design Development. This section should change little if at all from the PDR/CDR. Simply present the chosen architectural design, with any changes in response to the sponsors comments from the PDR/CDR.
    a. NOT REQUIRED IF SUCCESSFUL AT CDR: a review of your feasible alternatives – perhaps shown as hand sketches.
    b. NOT REQUIRED IF SUCCESSFUL AT CDR: Presentation of any or all of the following – logical arguments, analyses, mock-ups, test results, risk analysis, cost analysis, etc. - that argue for or against each feasible alternative, leading to a single recommended alternative.
    c. REPEATED AND UPDATED FROM PDR: Inclusion of enough design detail to complete a conceptual design – this is an architecture proposed through the subsystem level, which includes:
        i. *Undimensioned* CAD drawings - 3-D rendered CAD assembly drawings (Solid Edge) of design concept(s) – dimensions are not required yet, show the entire device, subassemblies and views of areas critical to understanding the concept.
        ii. Product hierarchy - A description of the subsystems and components, their interfaces, their logical and physical layout appropriate for a conceptual design.
        iii. Detailed CDR Economic Analysis - Include a Bill of Materials, such as a parts list, part costs and total cost, and your cost to manufacture.
    d. A course requirement is that each team demonstrate in either a, b or c:
        - Usage of modern engineering tools – e.g. commercial software such as FEA, Working Model and other simulation software, spreadsheets, data acquisition, CAD, etc. Update from CDR if changed.
        - Application of fundamental engineering analysis methods, based on simplified analytical models with calculations. Choose your calculation carefully, only do what is appropriate and necessary to your project. Discuss with your instructor what you plan on presenting here. Put calculations details in the appendix. Update from CDR if changed.
3. Requirements - List requirements that are derived and those that have originated from the sponsor or other stakeholders. Place these in outline form, the first outline level is the system level, followed by the subsystem level requirements, and component requirements if any at this time. Consider also requirements that are based upon economic, environmental, sustainability, manufacturability, ethical, health and safety, social, and political factors. Update from CDR if changed.
4. Concept of Operations (ConOps) – Describe how the system will operate. Add safe operating instructions here for the system.

5. Validate and Verify – Formulate a test plan, to be performed in Phase D to test the system to show that each measurable system requirement is met (this is System Verification). Present brief, preliminary test plan that will demonstrate that the system will function according to the ConOps and satisfy the mission objective (this is System Validation). Document your test results. Did your subsystems' test results satisfy requirements? If not, what action did you take to meet requirements? Did your system testing satisfy system-level requirements, can it perform the ConOps, and does it satisfy the mission objective?
6. Interfaces and ICD – List the mechanical, electrical, thermal and operational boundaries at this point in time, if any. Update from CDR if changed.
7. Mission Environment – Describe the mission environment and its effect, if any, on the design. Update from CDR if changed.
8. Technical Resource Budget Tracking – identify and estimate resource budgets if relevant and necessary - such as mass, volume, power, battery, fuel, memory, etc. Update from CDR if changed.
9. Risk Management – The systems engineer will be able to identify risks to safety, performance and program. Perform Failure Mode Analysis if called for. Update from CDR if changed.
10. Configuration Management and Documentation. Update the webpage and baseline the CDR documents. Summarize how the configuration is managed. Update from CDR.

SUBSYSTEMS DESIGN ENGINEERING –
Include 3-view orthographic projections, fully dimensioned, of all parts that must be manufactured. Drawing must adhere to the format in [3]. Drawings must be approved by the designer, drawer, and technical advisor. Include assembly drawings, schematics of hydraulic, pneumatic and electrical systems if needed. Complete parts list. Update and refine 3-D solid models, engineering analyses, economic analyses. Answer any concerns of industrial sponsor Update the design details of each subsystem based on any changes you made since the CDR, including dimensioned drawings (drafts) sufficient so that parts can be made, completed/updated analyses, complete bill of materials for each subsystem, assembly drawings and any schematics (e.g. hydraulic, electrical, etc.). Include safe operating instructions for the subsystem if appropriate.

PROJECT MANAGEMENT – Show project management structure (show how tasks are assigned on the basis of multifunctional areas), schedule of milestones and reviews, actual project costs, any Gantt Charts [5] or Work Breakdown Structure used during the semester. Updated for this semester. Total updated project costs need to be complete at presentation time, so that the sponsor can be billed – you will need to contact Kellie Wilson (wilsokm@auburn.edu) and request a final account summary.

CONCLUSIONS

Restate the primary information and results. Update. Add your overall observations and list of suggested tasks for future work.

APPENDIX AND REFERENCES

- Pages from catalogs and technical description for parts and components to be purchased.
- Information from suppliers, price quotes.
- Reference citations, e.g. textbooks, technical articles, etc.
- Details of calculations described in report.

An ORR Power Point Presentation is not Required, but Prepare a Demonstration

Demonstrate your prototype. In Systems Engineering parlance, this demonstration is a "System Validation" exercise. Perhaps demonstrate the system by operating in an environment that is as close to the operational environment as possible. Operate in a scenario to emulate the Concept of Operations as best you can, without performing the actual mission. Demonstrate as best you can that the system meets the mission objective.

At the ORR demonstration to your sponsor, turn in:

- *The ORR report hardcopies – minimum of 3 copies, with 1 copy with CODs attached for Dr. Beale. Discuss total number of copies needed with Dr. Beale.*
- *Your design notebook.*
- *Upload drawings and ORR report onto your webpage.*

References:

[1] MECH 4240-50 Class Web page: http://www.eng.auburn.edu/users/bealedg/MECH4240-50/
[2] Introduction to Communication: http://www.eng.auburn.edu/users/bealedg/MECH4240-50/#Q13
[3] Machine Drawing Format http://www.eng.auburn.edu/users/bealedg/MECH4240-50/#Q15
[4] Online Ethics Center for Engineering and Science: http://onlineethics.org/eng/cases.html
[5] Gant Chart online: http://www.ganttchart.com/