**AE 522/722**

**Aerospace Design & Design Laboratory II**

**Spring 2025**

**Preliminary Design Review (PDR)**

**To be delivered sometime on or before midnight Friday 14 March 2024**

Record and send both .pptx and video files to kuaerodesign@gmail.com

Dr. B. Will then share with experts.

Purpose: Get feedback from professionals and user community at an early design stage

Structure:

1. Title Slide with handsome faces, names & jobs
2. Mission Specification & Profile
3. Overarching Design Philosophy
4. Report Contents
5. Current State of Design
6. Coming Design Steps
7. Ask questions of experts, like: Are you aware of any other changes in aircraft design and/or configuration that can reduce personnel costs? Do you think the traveling public and/or operators could accept an aircraft configured like an AN-72 rather than a traditional 737/DC-9 configuration? While the engines are overhead and far away from the ground, do you see any other grounds operations considerations with keeping them in ground idle so as to reduce the number of start cycles and associated engine fatigue?

• Prepare in PowerPoint format

• Audience: industry and aircraft design engineers and experts

• Mark every page as: "Competition Sensitive for Evaluation Purposes Only"

• If you have a proprietary idea, mark that page as such

• Every team member should speak with Team Leader going first, introducing team

• Try to give similar amounts of time for each member

• Target 30 – 45 min. If it's a bit longer, that's okay, just keep it under 1 hr

• Thank audience for taking the time to review the work and will "look forward to feedback"

• Individual Competitors are not expected to have the same volume of material as full teams, this includes Avery, May and Will.

**Report Block 7**

Due 24 Mar. 2024 8am to kuaerodesign@gmail.com

**All Preceding Chapters and Contents, reworked as directed as well as Appendix A**

**Chapter 1 Introduction, Motivation, General Concept of Operations, Mission Specification and Profile**

\*\*Chapter Refinement\*\*

Update the Conops as recommended earlier, knowing that this is a "living document" and will change with time as the report matures.

**Chapter 2 Historical Review, Competition in the Market**

\*\*Chapter Refinement\*\*

Update Historical Review and Competition as directed by Dr. B. and/or if new info. has become available.

**Chapter 3 Abbreviated Operating Statement, Design Philosophy & Configuration Constraint Establishment**

\*\*Chapter Refinement\*\*

Update Design Philosophy and constraints as needed.

**Chapter 4 Objectives, Requirements and Design Optimization Function**

\*\* Chapter Refinement\*\*

Given new information, adjust the ancillary objectives listed in Report 2. Stretch Tier 0 Requirements to as many Tier 1 Flowdown requirements as possible. Construct and show the Tier 0 to Tier 1 Requirements and Objectives Flowdown Chart.

**Chapter 5 STAMPED Analysis**

(Weights, We, Wto, Wpl, Geometries, b, S, AR, Power or Thrust, Performance, Vmax, Vcr, any and all Ranges, costs)

\*\* Chapter Refinement\*\*

Continue STAMPED information generation. Track as many relevant variables as possible.

**Chapter 6 Candidate Configuration Matrix Establishment**

\*\* Chapter Refinement\*\*

Tweak configurations presented as discussed in small group discussions.

**Chapter 7 Application of Optimization Function and Requirements Flowdown Charts to Configurations and Downselection**

\*\* Chapter Refinement\*\*

Refine downselection arguments. Many of the lines of reasoning and scores presented were fundamentally unsupportable and the judges will call you out on that. Shore up lines of reasoning.

**Chapter 8 Weight Sizing**

Leave this one alone – concentrate on weight sizing in the appendix. Refine as necessary

**Chapter 9 Wing and Powerplant Sizing**

\*\* Chapter Refinement\*\*

Refine as the team sees fit. Work to place the design point in a suitable spot on the sizing chart.

**Chapter 10 Advanced Technologies and Design Concepts**

\*\* Chapter Refinement\*\*

Refine as the team sees fit. Work to place the design point in a suitable spot on the sizing chart.

Your team (or You in the case of individual competitors) is (are) considering some advanced technologies to give your design an edge. Avery and May MUST do this section. Explain these advanced technologies to the reader:

**10.1 Heilmeier's Catechism for the Advanced Technology**

In a short table or paragraph, answer the following questions.

1. What is it called?
2. What are we trying to do?
3. How does this currently get done?
4. What limits present approaches?
5. What is new about our approach?
6. Why, at this time, can our approach succeed?
7. What difference does our approach offer?
8. What are the “mid-term” and “final exams?”
9. How much will our approach cost?

**10.2 Operational and Physical Description and Concept of Technology**

Describe how the system's primary components and how they work individually and together. This description should be a bit deeper than the Heilmeier's Catechism above and should have one or more figures to explain the concept.

**10.3 State of the Art of the Advanced Technologies**

By using the library, consulting a Research Librarian, searching the Patent Gazettes and other resources, research the state of the art of the Advanced Technologies you are considering. Be sure to catalog all references you are looking at. Also, be sure to include relevant figures (with proper references, of course). Be more generous with figures rather than less -- you can always strip them later.

**10.4 Physical or Computational Research Performed**

If you have designed and performed any physical or computational research related to your advanced technology, describe the research and report the results here.

**10.5 State of Team or Individual Intellectual Property, IP Protection and/or Patent Filing**

Describe the state of the IP and any efforts you and your team are undertaking to protect the intellectual property.

**References** (always at end of report, before the appendices)

**Appendix A**

i.) List of all team member actions and contributions. Note that some team members may be assigned a "long term" job and may not show up as contributing to this section. That's okay, but it needs to be noted.

ii.) Draft an aesthetics survey sheet to pass out to people and get feedback on multiple designs for commercial aircraft designs.

**Appendix B Class I Weight Sizing Calculations**

Using the methods described in class, arrive at the Class I weight sizing of the aircraft. From this sizing exercise, you should determine: Wto, We, Wf, Wpl, Wpax, Woe, Wtfo and other important weights. Determine critical numbers like L/D cruise from STAMPED information on L/Ds of advanced aircraft derived from payload-range diagrams. Critical values for BSFC and TSFC can be obtained by looking at historical trending values. Show all calculations, which should in great part be done by hand and/or with spreadsheets and/or with Matlab code.

**Appendix C V-n Diagram Calculations**

Using the methods described in class and Roskam, Part V, place all of the calculations related to V-n diagram construction in this appendix.

**Appendix D Wing and Powerplant Sizing Calculations**

Using the methods described in class and Roskam, Part II, place all of the calculations related to wing and powerplant sizing in this appendix.

**Appendix E Class I Cockpit and Fuselage Layout Designs**

Following the procedures laid out in Roskam's Airplane Design, Part III, Lay out the Cockpit and Fuselage of your aircraft.

|  |  |  |  |
| --- | --- | --- | --- |
| **UG Missile & Interceptor** | **UG Individual,**  | **Grad. Team** | **Avery & May** |
| Treat your GNC package and the ground control system as your “cockpit.” Design the entire ground control system including communication network(s). Lay out the devices within the missile that will provide GNC. Include any mounts, mirrors, antennae and/or receivers. Provide a logical power system to provide at least a solid day of power to the missile before recharge is necessary in a preflight or bunker.  | Lay out your cockpit & fuselage. Bear in mind that you will have to have an “optionally piloted” aircraft with a removable cockpit pod. Weave a logical story of how that pod operates and how it’s installed and removed from the aircraft. The CAD doesn’t have to be fancy, just basic and functional at this point.  | Follow the procedures above.  | Avery: Complete logical grand scale ConOps. This is the large-scale system on the piece of paper. It’s currently missing and must be done. May: Delve into biochar plant in Valdosta. Get as much info. as possible. Try to determine how many board feet are produced by the sawmill as well as biofuel and biochar. Determine how close the next largest sawmill is and try to get sawmill map for the SouthEast US. Examine also Canada, especially Quebec and Ontario.  |

**Appendix F Class I Engine Installations**

Following the procedures laid out in Roskam's Airplane Design, Part II

Addendum:

i.) Start long-term projects for coming reports, identify person(s) responsible for each:

 a.) Initiate Class I Configuration Definition (enter in AAA)

 b.) Initiate Class I Performance Estimation (enter in AAA)

 c.) Initiate Class I Cost Analysis (translate Roskam Part VIII equations into Word and begin analysis in AAA)

ii.) List of all team member actions and contributions. Note that some team members may be assigned a "long term" job and may not show up as contributing to this section. That's okay, but it needs to be noted.

**Appendix G Class I Wing Layout Designs**

 Lay out your wing as covered in Roskam's Airplane Design Part II and as shown in class.

|  |  |  |  |
| --- | --- | --- | --- |
| **UG Missile**  | **Interceptor** | **UG Individual & Grad. Team** | **Avery & May** |
|  Follow Fleeman for initial wing, canard and tail sizing. Minimize as allowable, considering high lift (below) may necessitate a strake.  | Follow above procedures, with advisement from canard-configured European fighters and NASA-TN-D-7814  | Follow the procedures above.  | Avery: Look for papers and other publications describing the lack of H2 feasibility. May: Continue to analyze US and global biochar industry. Make first PowerPoint-level sketches of the various feedback loops for your paper.  |

**Appendix H Class I High Lift Device Sizing**

 Perform Class I High Lift Device Sizing as covered in Roskam's Airplane Design Part II and as shown in class. If your aircraft uses some mechanism other than flaps to generate high lift coefficients, describe those devices in greater detail and model to the best of your ability. Bear in mind that often deflected slipstream techniques can be quite effective and easy to implement.

|  |  |  |  |
| --- | --- | --- | --- |
| **UG Missile**  | **Interceptor** | **UG Individual & Grad. Team** | **Avery & May** |
|  Model the 180 deg turn going after low subsonic inbound target. Determine max. g’s, accounting for fuel consumed, determine wing/strake size to make the turn for aft intercept of low subsonic inbound target.  | Follow above procedures, with advisement from canard-configured European fighters and NASA-TN-D-7814  | Follow the procedures above.  | Avery: Look for papers and other publications describing the lack of H2 feasibility. May: Continue to analyze US and global biochar industry. Make first PowerPoint-level sketches of the various feedback loops for your paper.  |

**Appendix I Class I Empennage Design**

 Lay out your empennage as covered in Roskam's Airplane Design Part II and as shown in class.

|  |  |  |  |
| --- | --- | --- | --- |
| **UG Missile**  | **Interceptor** | **UG Individual & Grad. Team** | **Avery & May** |
|  Lay out the empennage for both stability and full flight control. Match canard or tail volume coefficients of similarly guided missiles.  | Follow above procedures, with advisement from canard-configured European fighters and NASA-TN-D-7814  | Follow the procedures above.  | Avery: Look for papers and other publications describing the lack of H2 feasibility. May: Continue to analyze US and global biochar industry. Make first PowerPoint-level sketches of the various feedback loops for your paper.  |

**Appendix J Class I Landing Gear or Launcher Layout**

|  |  |  |
| --- | --- | --- |
| **UG Missile**  | **Interceptor, UG Individual & Grad. Team** | **Avery & May** |
|  Design a logical launcher device including any/all launch rails, lugs, supports, etc. Design also a suitable series of cases for storage and transport. Separate the cases into one for the airframe, one for rocket motors and a third for warheads.  | Lay out your landing gear as covered in Roskam's Airplane Design Part II and as shown in class. | Avery: Decide on Honors approach, find suitable Journal and/or conference for presentation of honors research. Find Airbus H2 study if possible. Search and reference more documents regarding H2 flight, total aircraft operations and system -level fesibility. May: Continue to analyze US and global biochar industry. Make first PowerPoint-level sketches of the various feedback loops for your paper.  |

**Appendix K Class I Weight and Balance Analysis**

|  |  |
| --- | --- |
| **Interceptor, UG Individual & Grad. Team** | **Avery & May** |
| Perform your Class I weight and balance analysis as covered in Roskam's Airplane Design Part II and as shown in class. | Avery: Decide on Honors approach, find suitable Journal and/or conference for presentation of honors research. Find Airbus H2 study if possible. Search and reference more documents regarding H2 flight, total aircraft operations and system -level fesibility. May: Continue to analyze US and global biochar industry. Make first PowerPoint-level sketches of the various feedback loops for your paper.  |

i.) Continue long-term projects for coming reports:

 a.) Class I Configuration Definition (enter in AAA)

 b.) Class I Performance Estimation (enter in AAA)

 c.) Class I Cost Analysis (translate Roskam Part VIII equations into Word and begin analysis in AAA)

ii.) List of all team member actions and contributions. Note that some team members may be assigned a "long term" job and may not show up as contributing to this section. That's okay, but it needs to be noted.

ii.) Identify and Interview Experts

**Report Block 8**

Due 31 March 2025 8am to kuaerodesign@gmail.com

**All Preceding Chapters & Contents, reworked as directed as well as Appendices A – K.**

**Appendix L Class I Stability and Control Analysis**

 Perform a Class I Stability and Control Analysis as covered in Roskam's Airplane Design Part II and as shown in class.

**Appendix M Class I Drag Polar and Performance Analysis**

 Perform your Class I Drag Polar and Performance analysis as covered in Roskam's Airplane Design Part II and as shown in class.

i.) Continue long-term projects for coming reports:

 a.) Class I Configuration Definition (enter in AAA)

 b.) Class I Performance Estimation (enter in AAA)

 c.) Class I Cost Analysis (translate Roskam Part VIII equations into Word and begin analysis in AAA)

ii.) List of all team member actions and contributions. Note that some team members may be assigned a "long term" job and may not show up as contributing to this section. That's okay, but it needs to be noted.

ii.) Identify and Interview Experts

**Report 9 AIAA Individuals, Team & Swarm**

Due 27 March 2024 8am to kuaerodesign@gmail.com

**All Preceding Chapters & Contents, reworked as directed as well as Appendices A – K.**

**Appendix M Class I Drag Polar and Performance Analysis**

 Perform your Class I Drag Polar and Performance analysis as covered in Roskam's Airplane Design Part II and as shown in class.

**Appendix N Analysis of Weight and Balance, Stability and Control and L/D Results and Iterations**

**Appendix O Preliminary Three-View and List of Salient Characteristics**

**Appendix P Class I Layout of Major Systems**

 12.1 Landing Gear Layout

 12.2 Flight Control Systems

 12.3 Fuel System

 12.4 Hydraulic System

 12.5 Electrical System

Upcoming, not due yet:

 12.6 Environmental Control System

 12.7 Cockpit Instrumentation

 12.8 De-Icing, Anti-Icing, Rain Removal & De-Fog

 12.9 Escape System

 12.10 Water and Waste Systems

 12.11 Safety and Survivability

i.) Continue long-term projects for coming reports:

 a.) Class I Configuration Definition (enter in AAA)

 b.) Class I Performance Estimation (enter in AAA)

 c.) Class I Cost Analysis (translate Roskam Part VIII equations into Word and begin analysis in AAA)

ii.) List of all team member actions and contributions. Note that some team members may be assigned a "long term" job and may not show up as contributing to this section. That's okay, but it needs to be noted.

ii.) Identify and Interview Experts

**Critical Design Review (CDR)**

**To be delivered sometime on or before 8am Monday 8 April 2024**

Dr. B. Will then share with experts.

Purpose: Get feedback from professionals and user community at an early design stage

Record and send both .pptx and video files to kuaerodesign@gmail.com

Structure:

1. Title Slide with handsome faces, names & jobs
2. Mission Specification & Profile
3. Overarching Design Philosophy
4. Report Contents
5. Current State of Design
6. Coming Design Steps
7. Ask questions of experts, like: Are you aware of any other changes in aircraft design and/or configuration that can reduce personnel costs? Do you think the traveling public and/or operators could accept an aircraft configured like an AN-72 rather than a traditional 737/DC-9 configuration? While the engines are overhead and far away from the ground, do you see any other grounds operations considerations with keeping them in ground idle so as to reduce the number of start cycles and associated engine fatigue?

• Prepare in PowerPoint format

• Audience: industry and aircraft design engineers and experts

• Mark every page as: "Competition Sensitive for Evaluation Purposes Only"

• If you have a proprietary idea, mark that page as such

• Every team member should speak with Team Leader going first, introducing team

• Try to give similar amounts of time for each member

• Target 30 – 45 min. If it's a bit longer, that's okay, just keep it under 1 hr

• Thank audience for taking the time to review the work and will "look forward to feedback"

**Report 10 Coleopters**

Due 3 April 2024 8am to kuaerodesign@gmail.com

Refine cut parts, demonstrate fit checks, mock up first incarnation of grid fins and take pictures of painted, free-standing components.

**Report 10 AIAA Individuals, Team & Swarm**

Due 3 April 2024 8am to kuaerodesign@gmail.com

**All Preceding Chapters & Contents, reworked as directed as well as Appendices A – K.**

**Appendix M Class I Drag Polar and Performance Analysis**

 Perform your Class I Drag Polar and Performance analysis as covered in Roskam's Airplane Design Part II and as shown in class.

**Appendix N Analysis of Weight and Balance, Stability and Control and L/D Results and Iterations**

**Appendix O Preliminary Three-View and List of Salient Characteristics**

**Appendix P Class I Layout of Major Systems**

 12.1 Landing Gear Layout

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 12.7 Cockpit Instrumentation

 12.8 De-Icing, Anti-Icing, Rain Removal & De-Fog

 12.9 Escape System

 12.10 Water and Waste Systems

 12.11 Safety and Survivability

i.) Continue long-term projects for coming reports:

 a.) Class I Configuration Definition (enter in AAA)

 b.) Class I Performance Estimation (enter in AAA)

 c.) Class I Cost Analysis (translate Roskam Part VIII equations into Word and begin analysis in AAA)

ii.) List of all team member actions and contributions. Note that some team members may be assigned a "long term" job and may not show up as contributing to this section. That's okay, but it needs to be noted.

ii.) Identify and Interview Experts

**Report 11 Coleopters**

Due 10 April 2024 8am to kuaerodesign@gmail.com

Refine cut parts, demonstrate fit checks, mock up first incarnation of grid fins and take pictures of

1. Free standing components
2. Components assembled into an aircraft
3. Components disassembled in case

**Report 11 AIAA Individuals, Team & Swarm**

Due 10 April 2024 8am to kuaerodesign@gmail.com

All Preceding Chapters & Contents, reworked as directed as well as Appendices A – K.

All previous sections +

Chapter 12 Class II Sizing of Landing Gear­­

Addendum

Chapter Q Class I Structural Layout

Chapter Z Compliance Matrix

i.) Continue long-term projects for coming reports:

 a.) Update Class II Configuration Definition with Class II Weights Information (enter in AAA)

 b.) Initiate Class II Performance Estimation (enter in AAA)

 c.) Initiate Class II Cost Analysis

 d.) Initiate Class II Stability and Control Analysis

ii.) List of all team member actions and contributions. Note that some team members may be assigned a "long term" job and may not show up as contributing to this section. That's okay, but it needs to be noted.

References (always at end of report)

**Report 12 Coleopters**

Due 17 April 2024 8am to kuaerodesign@gmail.com

Refine cut parts, demonstrate fit checks, mock up first incarnation of grid fins and take pictures of

1. Mocked up figures cut from foam core or Depron and assembled
2. .jpgs of all parts to be laser cut
3. Full assembly of Depron parts
4. Mock up of grid fins
5. Motor mounted in Depron frame

**Report 12 AIAA Individuals, Teams, Swarm, Missile**

Due 17 April 2024 8am to kuaerodesign@gmail.com

All previous sections +

Chapter 11 Class II Weight and Balance

Chapter 12 Class II Systems (as appropriate)

 12.1 Flight Control Systems

 12.2 Fuel System

12.3 Hydraulic System

12.4 Electrical System

12.5 Environmental Control System & Cabin Sterilization

 5.1. Pressurization System

 5.2. Pneumatic System

 5.3. Oxygen System

 5.4. Air Conditioning System

 5.5. Cabin Sterilization

12.6 Cockpit Instrumentation

12.7 De-Icing

12.8 Window Rain, Fog and Frost Control

12.9 Escape Systems Ingress/Egress Systems and Compatibility

12.10 Lavatory, Galley, Water and Waste Systems

12.11 Safety and Survivability

12.12 Checked Baggage or Major Cargo Handling Systems

12.13 Cabin Baggage or Infantry Accommodations

12.14 Ground Equipment and Vehicles Compatibility

Chapter 13 Fault Tree Analysis of Flight Critical Systems

Chapter Z Compliance Matrix

i.) Continue long-term projects for coming reports:

 a.) Update Class II Configuration Definition with Class II Weights Information (enter in AAA)

 b.) Initiate Class II Performance Estimation (enter in AAA)

 c.) Initiate Class II Cost Analysis

 d.) Initiate Class II Stability and Control Analysis

ii.) List of all team member actions and contributions. Note that some team members may be assigned a "long term" job and may not show up as contributing to this section. That's okay, but it needs to be noted.

References (always at end of report)

ii.) List of all team member actions and contributions. Note that some team members may be assigned a "long term" job and may not show up as contributing to this section. That's okay, but it needs to be noted.

References (always at end of report)

**Report 13 Coleopters**

Due 24 April 2024 8am to kuaerodesign@gmail.com

Refine cut parts, demonstrate fit checks, mock up first incarnation of grid fins and take pictures of

1. Mocked up figures cut from foam core or Depron and assembled
2. .jpgs of all parts to be laser cut
3. Full assembly of Depron parts
4. Mock up of grid fins
5. Motor mounted in Depron frame

**Report 13 AIAA Individuals, Teams, Swarm, Missile**

Due 24 April 2024 8am to kuaerodesign@gmail.com

All previous sections +

Chapter 14 Class II Stability and Control

Chapter 15 Class II Performance with Electric Motors and Energy Handling

Chapter 16: Advanced CAD 3-View, Situational Rendering & Exploded View

Chapter Z Compliance Matrix

i.) List of all team member actions and contributions. Note that some team members may be assigned a "long term" job and may not show up as contributing to this section. That's okay, but it needs to be noted.

References (always at end of report)

**Report 14 AIAA Individuals, Teams, Swarm, Missile**

Due 1 May 2024 8am to kuaerodesign@gmail.com

All previous sections +

Chapter 17 Manufacturing, Fielding, Logistics, Handling & Deployment

Chapter 18 Class II Cost Analysis

Chapter Z Compliance Matrix

i.) List of all team member actions and contributions. Note that some team members may be assigned a "long term" job and may not show up as contributing to this section. That's okay, but it needs to be noted.

References (always at end of report)