

**Cyber Blue – Team 234**

**Perry Meridian High School**

**Indianapolis, IN**

## **Design Review Process Documentation**

**This document is intended for use, adaptation and adoption by FIRST robotics teams. This design review process has proven to be a valuable tool for Cyber Blue and it is willingly shared with the FIRST community.**

# Cyber Blue 234 – Design Review Process

## Topics:

Design Review Process – Introduction

Project Management

Selection of Review Team

Gated Review – Steps

- \* Goals and Objectives Setting

- \* Requirements Documents

- \* Reviews

Risk Mitigation Activity

In-Service Reviews

Root Cause / Corrective Action

## **Design Review Process – Introduction**

Many successful engineering based companies utilize review processes to improve the probability of success on new projects. Success may be measured by schedule, cost, reliability, safety or other factors.

The intent of the review process is for the project team to present the current status of the program to an independent audit team and allow the auditors to ask questions, identify potential problem areas and direct future actions of the project team as required. The auditors are not there to tear the project apart, but instead to make it better. The auditors are usually company employees working in other areas of the business.

In many companies, projects have “gated reviews”. At each major phase in the project specific requirements must be met. Once the requirements are met, the “gate” is opened to allow the project to move on to the next phase.

# Cyber Blue 234 – Design Review Process

## **Design Review Process – Introduction**

For the 2004 FIRST season, Cyber Blue adopted a gated review process with a goal to both improve the overall design of their robot and to introduce the team members to the process.

Cyber Blue implemented a 4 gate process with reviews for Concept, Preliminary Design, Detailed / Critical Design, and Production / Operational Readiness Review. In previous years, Cyber Blue has completed just one review, the Detailed Design / Critical Design Review.

Reviews included technical information on the robot as well as program status on outreach activities, animation and our Chairman's entry.

Prior to the kick-off, requirements for each gate were agreed and the schedule for reviews was set.

A review team was assembled and the reviewers agreed to the schedule.

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## **Project Management**

The first action taken by the team was to identify an overall program schedule. Microsoft Project was used for this function. Large copies of the schedule were posted in the teams meeting rooms.

The kick-off and ship dates were identified on the schedule. The team then identified target dates for major milestones such as an agreed concept, preliminary design, final drawings, drivable robot, completed robot and practice time.

Design review dates were set just before each of these major milestones. This allowed the team to present the proposed decisions to the reviewer and receive their comments before making the final decisions.

The program schedule is included in the following pages. The team was able to maintain most of the schedule but did not have the intended practice time before shipping the robot. In the coming weeks, the team will utilize a root cause / corrective action process to help improve this schedule for 2005.

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## **Selection of Audit (Review) Team**

Cyber Blue recruited a Technical Advisory Committee (TAC) from our two main sponsors – Rolls-Royce and Allison Transmission (General Motors).

The TAC members are all senior engineering managers and experienced in project and program evaluations. All TAC members committed to the review schedule.

In addition to the designated reviews, the TAC members attended the Kick-Off event to see and learn the game first-hand (this proved to be a great benefit to the process) and the team Open House just before ship date.

## **Gated Reviews - Steps**

The major steps to a successful gated review process are:

- \* Goals and Objectives Setting
- \* Schedule of Reviews
- \* Defining Documentation Requirements
- \* Conducting Reviews
- \* Risk Mitigation Activity
- \* Root Cause and Corrective Action Where Required

# Cyber Blue 234 – Design Review Process

## Goals and Objectives Setting

The first step in the process is to identify the required reviews, the goal of each review and the questions to be answered by the presenters. Each review had “exit criteria” that needed to be met before moving on to the next step.

Each review built on information and decisions made in the previous review and much of the presentation material was used at multiple reviews.

Cyber Blue determined that a Concept Review, Preliminary Design Review, Detailed / Critical Design Review and Production Review were required during the build season.

An informal “In-Service” review will be held to evaluate robot performance in actual competitions to determine if modifications are required.

The following pages identify each review and the goal and exit criteria.

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## Schedule of Reviews:

Day 1	January 10	Program Kick-Off
Day 6	January 15	Concept Review
Day 13	January 22	Preliminary Design
Day 20	January 29	Detailed Design / Critical Design
Day 34	February 12*	Production / Operational Readiness
Day 45	February 23	Demonstration Night / Open House

\* This review moved to February 16<sup>th</sup> due to review team travel conflict.

## **Defining Documentation Requirements**

The team operated to two major documents – the FIRST Robot manual and the team’s “Technical Requirements Document”.

The FIRST Robotics Manual provided the details of the game and build rules and requirements.

The Technical Requirements Document provided additional details specific to Cyber Blue. This document was developed and revised as the build season progressed and more requirements were defined.

At the final review, compliance to the Technical Requirements Document was demonstrated to the TAC.

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## Conducting Reviews - General

Each review was student developed and student led and adapted from templates from sponsoring company processes. All but one review was held at the school, in the robot build area to provide easy access to parts and drawings.

The Concept Review was very informal, with sketches, chalk board drawings and wooden prototypes.

The Detailed Design / Critical Design was the most significant review with a formal slide presentation and larger review panel. This review was held at the Rolls-Royce facility.

The Technical Advisory Committee watched, listened, asked questions and provided advise and comments at each step.

Cyber Blue team members captured notes and comments at each review. These comments were then discussed at the next meeting and many implemented right away. Presentations and notes from each review are maintained in a file.

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## **Conducting Reviews – Kick-Off**

### GOAL:

Introduce students and review panel to the 2004 Robotics Challenge.

### EXIT CRITERIA:

None

## Conducting Reviews – Concept Review

### GOAL:

Gain approval of the feasibility of the robot concept(s) presented.

### EXIT CRITERIA / PRESENTATION:

Presentation of multiple concepts and process to determine final selection.

Descriptions of concepts still under consideration to carry forward.

Program Schedule

Matrix of the following for evaluated concepts:

Critical Features / Critical Capabilities / Risks

Technology Requirements / Resource Requirements

## **Conducting Reviews – Preliminary Design Review**

### GOAL:

Gain approval of the viability of the robot concept presented.

### EXIT CRITERIA / PRESENTATION:

Presentation of a fully developed single concept.

Explanation of final decisions leading to the selected concept.

Program Schedule

Description of concept selected:

Critical and Key Features / Critical and Key Capabilities

Preliminary Risk Matrix, Key Risks, Mitigation Actions

Technology Requirements / Resource Requirements

## **Conducting Reviews – Detailed / Critical Design Review**

### GOAL:

Confirm the viability of the robot and progress of design activity

### EXIT CRITERIA / PRESENTATION

Complete design definition and Analytical verification of design decisions.

Safety assessment / Durability assessment / Testing plans

Program schedule

Description of robot

Critical and Key Features and Capabilities

Updated Risk Matrix, Key Risks, Mitigation Actions

Technology Issues / Resource Issues

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## **Conducting Reviews – Fabrication / Operational Readiness**

### GOAL:

Confirm the viability of the robot to be constructed as designed.

Confirm the viability of the robot to perform as intended.

### EXIT CRITERIA / PRESENTATION

Confirmation that the Requirements of FIRST have been met

Confirmation that the Requirements of Cyber Blue have been met

Robustness of design

Capabilities

Program Schedule

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## **Conducting Reviews – Demonstration Night / Open House**

### GOAL:

Demonstration of robot capabilities, driving, strategy in action.

Celebrate completion of the program

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## Risk Mitigation Activity

As part of the overall review process, risks were identified during each phase of the project and discussed internally and with the TAC.

The team was introduced to a process of “IF / THEN” risk identification and mitigation. Each student was required to identify 3 risks to add to the overall risk matrix.

IF – Identify an action or event that might occur

THEN – Identify what happens when the IF occurs

LIKELIHOOD – Identify how likely the IF statement is to occur

IMPACT – identify the impact to the program when the IF occurs

*Likelihood and Impact are indicated as Low (L), Medium (M) or High (H)*

MITIGATION - Identify what can be done to remove or reduce the likelihood of the IF occurring

## Risk Mitigation Activity

### EXAMPLE

IF the pneumatics lose pressure when power is cut

THEN the robot might drop back to the floor

LIKELIHOOD – High with the wrong solenoids

IMPACT – HIGH (loss of 50 points)

MITIGATION – Use only double acting solenoids so that pressure is maintained when power is cut at the end of the match.

## **Risk Mitigation Activity**

Risks are then ranked by likelihood and impact and effort is focused on mitigating the higher likelihood and higher impact risks first.

At one of the reviews, one member of the TAC also suggested we also identify cost of mitigation in our matrix. Cost could be dollars or time or impact to the rest of the robot design. This added information lets the team decide to mitigate some risk that might be low likelihood / low impact that is low cost or very easy to correct.

Some risks cannot be mitigated due to costs, time, weight, power or other factors.

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## **In Service and Post Season Reviews:**

During competitions, the team is completing ongoing, informal “In-Service Reviews” based on how the robot performs during matches. The data obtained from competition performance will be captured and used to make modifications to the robot and to improve future designs.

A formal “post season” review will again identify what the team and the robot did well and what could be improved. Notes from this review will be used as the team launches the 2005 first season.

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## **Root Cause / Corrective Action:**

The team will be utilizing a Root Cause / Corrective Action (RCCA) process to continually improve the performance of the team and the robot.

The first RCCA event will be completed during the competition season. This review will address the causes of the schedule delays leading to limited practice time for the robot and will be led by a Black Belt / Six Sigma expert from Rolls-Royce.

Following the competition season, other RCCA events will be scheduled as required.

# Cyber Blue 234 – Design Review Process

## **Electronic Data:**

This document may be downloaded electronically from either

<http://www.cyberblue234.com>

Resources Tab - Cyber Blue 234 Design Review Process 2004

(Or)

[www.chiefdelphi.com/forums/papers.php](http://www.chiefdelphi.com/forums/papers.php)

- Team Organization Section, Cyber Blue 234 Design Review Process 2004

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