

# Conceptual Design Report

**Course:** GNG1103–Engineering Design

**Team Name:** Five Alive

**Date:** [2025.02.09]

**Team Members:** Sam Stano, Owen Kaine, Aidin Moradi, Ziyi Wang

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# 1. Introduction

This reports on the conceptual designs developed in an effort to address the problem statement crafted by the team. These have been developed through preceding benchmarking of both technical and user requirements and ranked in terms of requirements for design. The purpose of this deliverable is to detail subsystems, generate subsystem concepts, evaluate them, and select the most viable worldwide solution for development.

## 2. Subsystem Definitions

The overall design has been broken down into the following subsystems, each with distinct boundaries to ensure interchangeability:

1. **Sample collector and mass reader**
2. **Scraper**
3. **Failsafe**
4. **Operator control system**
5. **Mobility Subsystem**

## 3. Concept Generation

Each team member generated at least one concept per subsystem. The specific team member responsible for each concept is noted below.

### 3.1 Subsystem A Concepts [Aidin]

1. Open container with digital scale in it that can send feedback to user.
2. Magnet to attract bits a scraped metal falling from the drill bit.
3. Funnel to collect bits of metal and direct them to a narrow weight sensor.
4. Rope that latches onto the container that collects the metal and runs through the whole system. This rope can be unlatched to remove the container.
5. Rope system that the operator can pull to close the lid of the container

### 3.2 Subsystem B Concepts [Sam]

1. A two-point adjustable arm with drill bit attached to the end for scraping.
2. Vibration sensor with Arduino to detect contact with wall.

### 3.3 Subsystem C Concepts [Owen]

1. Umbrella-like attachment at the front that drags any fallen objects out.
2. Strong cord through the design to attach all parts in case of breaking.
3. 5, 1-meter-long pipes attached with joints that are flexible in case of curvature in the tube length.

### 3.4 Subsystem D Concepts [Ziyi]

1. This operator control system is mainly used to provide clear feedback to the staff.
2. Corded console controller with coded controls for different functions.
3. Green light for contact of scraper with the wall of the pipe.
4. There is no contact, the controller will light up red.

### 3.5 Subsystem E Concepts [Sam]

1. Remote RC car/robot with attachments put together on top.
2. Wheels that are attached to the main structure of the scraper and are the diameter of the tube to center the main body of the scraper system.

## 4. Refinement of Subsystem Concepts

After discussion, the team refined and condensed the concepts to create the following final subsystem options:

1. **Final Concept A:**  
Scraping and vibration sensor device:  
Drill bit to control speed and intensity of scraping with Arduino vibration sensor to detect contact with walls.
2. **Final Concept B:**

For our second design concept we Integrated Sample Collection (mass reader) and Failsafe System. This system is designed to simultaneously collect weight and provide accurate mass readings. It incorporates a small-scale sensor. The light weight.

### 3. **Final Concept C:**

This operator control system is a wired controller. The operator can get clear feedback through this controller and can observe where the tool is damaged in this system. And most importantly, the protective device. Regarding the feedback part, when the scraper is in contact with the pipe wall, the controller will light up green. When there is no contact, the controller will light up red.

## 5. Global Solutions

The subsystems were combined into three distinct global solutions, each represented by a sketch.

### 5.1 Drill Bit Scraper with Arduino Vibration Sensor

1. The Scraping and Control system were combined.
2. A rotating drill bit with variable speed will precisely scrape away material from the inside of the tube, getting feedback on wall position and pressure from an Arduino vibration sensor.
3. The speed can be controlled for more precise scraping. The sensor will give accurate feedback on how much pressure the drill bit is applying to the surface before drilling. Signal may be interfered with by the radioactive waves so it may need to be wired to be efficient.

### 5.2 Precision Balance System

1. The Sample Collection (mass reader) and Failsafe System were integrated.
2. One of the challenges is that it will not be cost-efficient since it will incorporate high-tech sensors.
3. The benefits include a precision scale providing real time, accurate mass measurements for collecting data.

## 5.3 Integrate the system using the control system

1. The Scraping, Failsafe and Control system were combined.
2. The control system plays an integrating role. Our plan is to integrate as many functions as possible into this system.
3. The advantage of this is that the operator can complete all tasks with just one controller and get the feedback they deserve. The disadvantages are the high cost and the fact that there is no guarantee that the system will work the first time.

## 6. Justification of Selected Solution

The selected solution is the drill bit and Arduino sensor. It was chosen due to our belief that it will be able to precisely remove material and be cost-effective. Key benefits include:

1. The drill speed can be controlled so there is no accidental material removed from it spinning too fast at one speed.
2. The sensor gives accurate feedback on contact with walls and pressure being applied by the drill bit.

Drawbacks were also considered, and potential mitigations include:

1. The drill bit overheating while shaving away material.
2. Arduino accessories could become costly.

## 7. Client Meeting 2 Preparation

A presentation has been prepared to present multiple concepts to the client and gather feedback. The presentation will:

1. Validate the problem statement.
2. Seek feedback on design direction and target specifications.

Key questions for the client include:

1. Can signals pass through the walls and if not, will a corded connection fix it.

2. Would it be plausible to measure our mass by a scale or should we focus more on our collection device accurately taking a sample.
3. What aspects of our design are convenient for a nuclear environment and what aspects aren't as effective?

## 8. Task Plan Update

Team Member	Tasks Completed Last Week	Current Tasks (In Progress)	Tasks On Hold or Canceled	Estimated task duration
Aidin	Deliverable C	Deal with any group issues or disagreements and develop strategies to help with conflicts.	None	2 Days
Owen	Deliverable C	Determine what tasks have been finished, what upcoming tasks are and if anything needs to be put on hold or cancelled.	None	2 Days
Ziyi	Deliverable C	Verify and update task start dates and consider everyone's availability over the next two weeks.	None	2 Days
Sam	Deliverable C	Update Trello to account for Deliverable D	None	2 Days

		and create more detailed sub tasks for upcoming weeks.		
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## 9. Conclusion

To conclude, the group had a successful meeting. First, raw ideas for different subsystems were written out then through review the ideas were redefined. Next, we all drew our ideas to demonstrate our concepts to one another. These drawn ideas were added to a slide show to present to the client and have visuals for better understanding.