GNG 1103 – Engineering Design Faculty of Engineering – University of Ottawa

Design Criteria & User Benchmarking

Group 9

Derek Villanueva, Trey Belanger, Berk Orkmez, Tim Maley

Functional Needs (1-Most Important, 5-Least Important)		
Importance Rank	**Needs**	**Design Criteria**
1	The device needs to be removed in case of emergency	Fail-Safe
2	The device needs to be able to take samples ranging from 30-80mg	Sample Size (mg)
3	The tool can be used vertically or horizontally	Operation Orientation
4	The tool needs to reach 15ft into the pipe	Minimum Reach (ft)

Non-Functional Needs (1-Most Important, 6-Least Important)		
Importance Rank	**Needs**	**Design Criteria**
5	The device needs to provide feedback during the sample retrieval process (What current state it is in)	Provides Feedback
4	The tool needs to be reusable	Product Uses (# of uses)
3	The tool needs to be man-portable	Weight (lbs) Modular
1	The tool must collect the sample in a removable container	Removable Container
6	The tool must collect the sample in a timely manner	Operation Time (Minutes)
2	The sample must not come into contact with the operator	Removable Container

Constraints

- When the sample is removed from the tube, it must be stored in a suitable container such that direct contact between the tool operator and the sample does not occur.
- The tooling shall provide a method for adjusting the sample retrieval process and/or mechanism to ensure the metal sample is between 30 and 80 mg.
- The tool shall provide feedback to the operator to confirm the tool and process status.
- The tooling shall be designed to be fail-safe, such that all equipment can be removed from the tube in the event of equipment failure.
- All sampling equipment shall be modular to have the capability to be broken down into man-portable sizes.
- Any necessary power sources shall be included in the design of the system.
- Cost less than or equal to $100.
- Reach 15 feet into the pipe.
- Work vertically or horizontally.

What Other Companies Are Doing

- Controlled by a programmable logic controller
- Casing scrapers
  - Use multiple blades to scrape the insides of the pipe
  - Made of cast steel
  - Uses springs to keep blades in contact with the inside of the pipe
- Uses rubber seals to keep the tool centered in the pipe
- Pipeline pigs
  - “Tracking pigs” use signal transmitters to provide feedback to the user on the pig’s location
  - Scrapes the pipe using brushes
  - Uses “wire wheel” brush configurations
- Created for long-term use
- Sample Lance Scraper
  - Stainless Steel
  - PTFE
  - Rotating wall closing mechanism to contain sample

Target Specifications	
Dimensions(LxWxH)	(3ft x 4in x 4in)
Total Weight (lb)	≤ 20lb
Operation Time (min)	Approximately 5 min
Sample Size (mg)	30-80mg
Reach (Ft)	≥ 15ft
Cost ($ CAD)	≤ $100 (CAD)

Reflection:

During the client meeting, CNL expressed concern about several key requirements which provided the foundation for our design criteria. One of these requirements included a sample being retrieved 15ft from the tube inlet. CNL also mentioned the importance of the sample being between 30-80 mg in order to get a proper analysis of the amount of hydrogen within the samples. Due to the high-risk environment and radioactive material, the client mentioned the sample must not come into contact with operators and should be easily removed from the tool. Due to the complexity of the reactor and the sensitive environment, CNL also requires that the tool has a failsafe so that in the event of the tool breaking it is able to be retrieved easily.

References

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[5] Burkle, “Sample Lance Scraper - all-layer or multi-point Samples of Agglomerating Powders and Granulates 3 St 180 Ml,” *Buerkle.de*, 2025. https://www.buerkle.de/en/sample-lance-scraper_p5351-1000 (accessed Jan. 29, 2025).