
BENCHMARKING AND TARGET SPECIFICATIONS

Deliverable C

Client – Canadian Nuclear Laboratories

GNG1103-F

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Introduction:

CANDU reactors play a vital role in Canada's nuclear energy sector, relying on complex fuel pipe systems that require careful monitoring and maintenance. To ensure the safety and efficiency of these reactors, the Canadian Nuclear Laboratories must develop a system that meets strict regulatory requirements while addressing practical operational challenges. This report focuses on defining a prioritized set of design criteria, including functional and non-functional requirements, constraints, conducting technical benchmarking, as well as establishing target specifications to guide the development of an effective solution. These steps are crucial for shaping the project's direction, as we define its scope while ensuring that the final solution meets both the client's needs and industry regulations. By establishing well-structured design criteria and measurable benchmarks, the development process remains aligned with user expectations and technical requirements.

Design Criteria:

Priority	Need:	Criteria	Functionality
5	Product can efficiently retrieve radioactive material from a tube.	Must retrieve only 30-80 mg of material. Adjustable collection sensitivity.	functional
5	Product will include safety measures to prevent contamination.	Stores the material. Does not require contact.	functional
5	Product will be lightweight and portable for efficient transportation.	Weight (lbs). Size (in). Be carried by one person.	functional
4	Product will operate in both vertical and horizontal tubes.	Should not rely on direction. Be self supporting.	functional
4	Product will include failsafe mechanisms for safety.	Easily retrievable.	functional
3	The product will provide operator feedback for better efficiency and safety.	Sends feedback of what stage it is in.	functional

2	Product will adapt to slight deviations in pipe structure.	Not fully rigid. Can slightly bend.	Functional
1	Product will primarily use batteries but can also be man powered.	Power input (V or Force).	Functional

Target Specifications:

Design Criteria	Value maximum	Verification method
Adjustable collection sensitivity.	30 – 80 mg of material	Testing
Stores the material	N/A	Design
Be carried by one person.	Weight - 5 lbs Size (while turned off) - 12in by 12 in	Measuring
Self Supporting	N/A	Testing
Omni directional	N/A	Testing
Easily Retrievable	N/A	Testing, Design
Not fully rigid	Deviate by 1 cm	Testing, measuring
Power Input	Volts or Force	Measuring, testing.
Budget	\$100	Calculation

Technical benchmarking

Retrieval and inspection system	Product 1: Jiutai sewer/pipeline inspection robot	Product 2: Robotic pipe handler RPH 7000	Product 3; Motorized gripper retrieval tool
Description	Robot inspection device that can travel within a pipeline inspecting its status. Includes a telescopic and camera device to	Consist of manipulation arms that enter the pipeline which can drill, cut, and overall modify the pipe (this product is quite large, but the	Has the ability to grab and remove objects or material that is up to 100 ft away and includes different attachments to

	visualize the contents within the pipe	idea of this product still holds much value) during the technical benchmarking phase	enhance its overall function
Company	Zhengzhou Jiutai Technology Co	Canrig Robotics	Advanced Inspection Technologies
Cost	\$9500	N/A	N/A
weight	33.0 Kg	65000 kg	N/A
dimensions	Single package size 60x45x55 cm	32.25 meters in height	50-foot cables 0.81-inch diameter
Material	N/A	N/A	Stainless steel
Sample retrieval tool/scrap tool	Product 4: Rotary Electrofusion pipe scrapper	Product 5: Electrofusion pipe scrapper	Product 6: optical odometry sensor
Description	Has blades that enters the pipe and scrapes the walls of it thoroughly,	Can be connected to a drill and scrap the inside or outside of the pipe using fastened blades at small angles allowing for more of a shaving function.	Uses visual data from a camera or optical system to track movement of a device and determines its position.
Company	Qingdao Polyfusion Machinery Co., Ltd.	Chengdu Chuangrong trading Co	Spark fun Electronics
Cost	\$340-370	\$50 - 100	\$79,95
weight	4.7 kg	1.3 kg	N/A
dimensions	Single package size 35x26x12 cm	Package size 50x42x26 cm	1 inch x 1 inch
Material	Aluminum alloy	N/A	N/A

Conclusion:

Clearly defining design criteria and target specifications is essential for developing a solution that effectively meets the requirements of the Canadian Nuclear Laboratories. By systematically prioritizing functional and non-functional needs, analyzing existing technologies, and setting quantifiable goals, the team ensures that the project remains

well-organized and progresses toward a practical and efficient final product. Additionally, refining the task plan allows for better collaboration and project management, ensuring steady progress toward a viable final product. Through this structured approach, the project moves closer to delivering a solution that enhances the safety and reliability of nuclear fuel pipe inspection and maintenance systems.

Work Cited

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