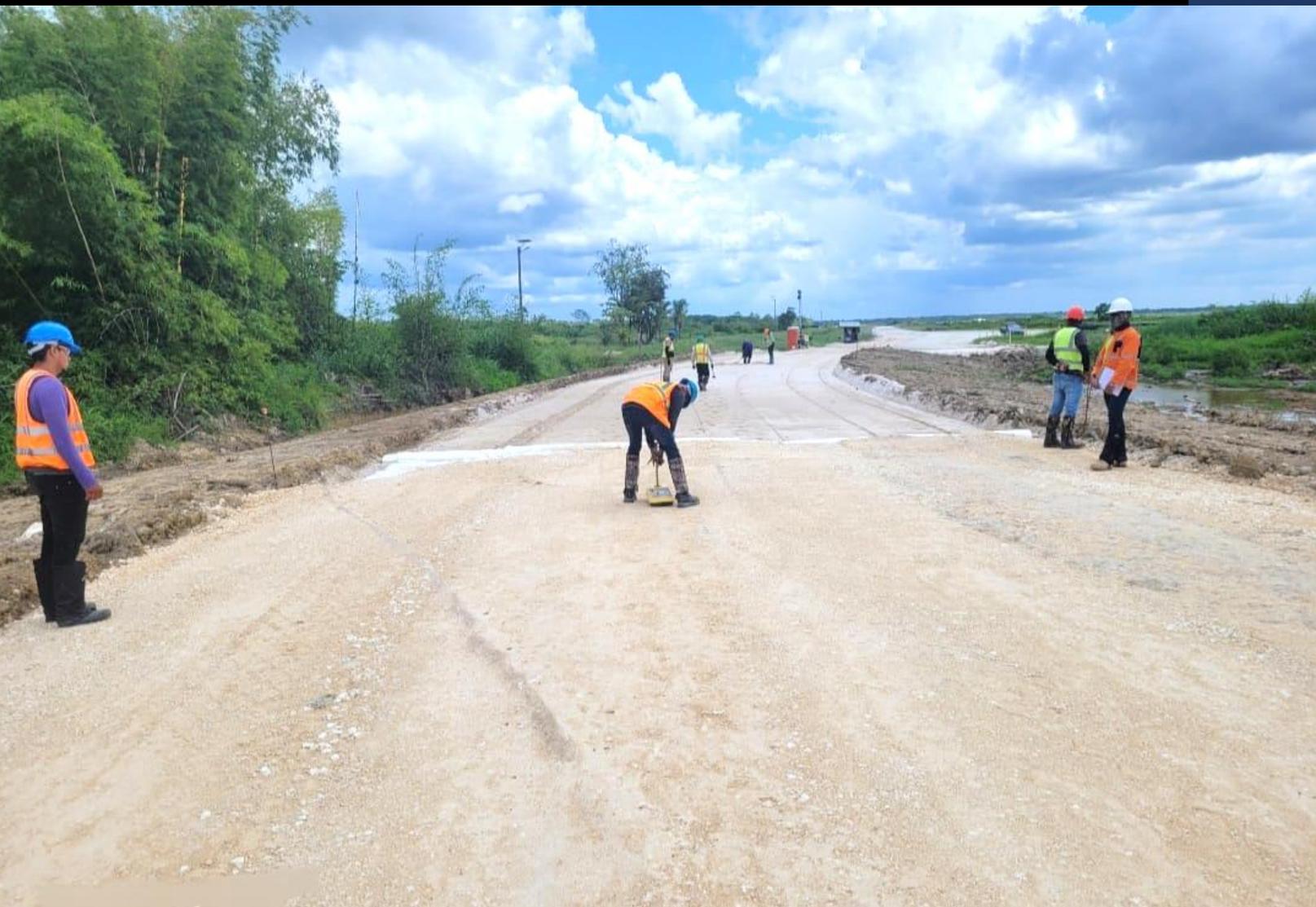




2024

GR ENGINEERING COMPANY PROJECT SUMMARY



Submitted by:
GR Engineering Company

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1. PREVIEW

GR Engineering Company is hereby requesting for an environmental permit to operate three (3) nuclear density gauges in their operations.

2. PROJECT SUMMARY

GR Engineering Company is an engineering consultancy which offers construction supervision, design and construction materials testing services to the Government and Private Sector of Guyana. GR's Office is located at Lot 477 Block 8 Mon Repos, ECD, Guyana.

Nuclear density testing is one of the tests we offer. GR Engineering Company currently owns three (3) nuclear density gauges. All three gauges are located in Guyana. The gauges contain radioactive materials - Cesium-137 and Americium-241:be. Whilst the Company's office is located at Mon Repos, the gauges are stored at a commercial plot at Triumph Backland, Agriculture Road, Guyana.

The Project herein referred to in this Report describes GR Engineering Company's intent to obtain an Environmental Permit to operate, maintain and store our gauges in conformity of safe use within the Environmental Protection Agency's Regulatory Framework.

Expected Lifetime of the Project: The company began offering moisture density testing since 2021. GR Engineering Company intends to continue to provide moisture density testing service for the lifespan of the company, or in perpetuity of the Company.

3. DETAILED DESCRIPTION OF THE PROPOSED PROJECT (NON TECHNICAL EXPLANATION)

3.1 PURPOSE OF NUCLEAR DENSITY TESTING

Nuclear density testing is a method used in road or construction projects, construction sites and residential and commercial construction sites, to measure the density and inner structure of soil or asphalt. A nuclear density gauge is a testing device that uses low level radiation to measure the wet density, dry density, and moisture content of soil and granular construction materials.

Testing of compacted soil is very important, as the test will verify that the soil conditions are suitable to support structures, streets, highways, etc. Improper compaction can lead to serious problems. Over time, the soil may settle or slide, allowing water to pass underneath, which in time may lead to erosion and could cause damage to building foundations. Likewise, improper compaction in roads could result in the settling of pavement and cracking of pipes beneath the road.

The nuclear density gauge is comprised of a gamma radiation source (Cesium-137) and a neutron radiation source (Americium-241: Be) about the size of a pebble at the end of a source rod, and Geiger Mueller tubes embedded in the base at the other end of the gauge. The source rod is lowered into the ground and, once released from its shielded housing, gives off just enough radiation to measure density. The Geiger Mueller tubes detect the gamma radiation that is emitted from the radiation source and passes through the material under the gauge. By calculating the percentage of particles that return to the sensor, the gauge can be calibrated to measure the density and inner structure of the test material.

Some advantages to using a nuclear gauge to measure soil samples are that the tests are very quick and only take a few minutes to perform. This makes nuclear density testing the optimum method for large projects, which may require many tests per day, and it can be used on a wide range of soil types.

3.2 PHOTO OF THE NUCLEAR DENSITY GAUGE, GAUGE CASE AND OTHER TOOLS



4. GR's GAUGE INFORMATION

All three nuclear density gauges are from the following Manufacturer:

- Name: Humboldt Mfg. Co.
- Address: 2525 Atlantic Ave, Raleigh, NC 27604 USA
- Telephone: 800.537.4183
- Point of Contact: Tamla Warren, Sales & Operations Manager
- Email: tamla@humboldtmfg.com;

- Website: <https://www.humboldtmg.com/>
- GR Engineering Co Account Number: C155334
- Frequency of calibration: Every twenty-four (24) months

See below for specifics of each gauge:

| GAUGE #1 – GRNDG01 | GAUGE #2 – GRNDG02 | GAUGE #3 – GRNDG03 |
|--|--|--|
| Type of Gauge: HS5001-EZ | Type of Gauge: HS5001-EZ2 | Type of Gauge: HS5001-EZ2 |
| Manufacturer: Humboldt | Manufacturer: Humboldt | Manufacturer: Humboldt |
| Gauge Serial Number: 9851 | Gauge Serial Number: 10325 | Gauge Serial Number: 10404 |
| Source 1: Cesium-137 Type: Gamma Serial No. Q1205K | Source 1: Cesium-137 Type: Gamma Serial No. Q2373 | Source 1: Cesium-137 Type: Gamma Serial No. Q2446 |
| Source 2: Americium-241: Be Type: Neutron Serial No. K793-18 | Source 2: Americium-241: Be Type: Neutron Serial No. K831-21 | Source 2: Americium-241: Be Type: Neutron Serial No. K420-22 |
| Calibration Certificate and expiration: CURRENT | Calibration Certificate and expiration: CURRENT | Calibration Certificate and expiration: CURRENT |
| Expiring: June 21, 2024 | Expiring: January 25, 2025 | Expiring: May 4, 2025 |
| Condition Procured: Procured, new, direct from Manufacturer. | Condition Procured: Procured, new, direct from Manufacturer. | Condition Procured: Procured, new, direct from Manufacturer. |

5. CURRENT STORAGE LOCATION – AGRICULTURE ROAD, ECD, GUYANA

Gautam Singh Khan, owner of GSK Excavation Services Inc. granted permission to GR Engineering Company to store three (3) nuclear density gauges on his land in a locked and secured container. A security personnel is stationed on the plot to secure GSK’s equipment and GR’s gauges. Specifics of the industrial plot are as follows:

- Address: Lot 144 – 146 Section “A” portions of the Backland of Triumph, Agriculture Rd, ECD, Guyana.
- Owner: Gautam Singh Khan T/A GSK Excavation Services Inc.
- Acreage: 1.295 Acre

- GPS Coordinates: 6.783192, -58.062209

The land is located at the back of Agriculture Road, in a sparsely populated area, and away from residents.

6. PHYSICAL LOCATION AND ITS CHARACTERISTICS ALONG WITH GPS COORDINATE/S

| No | Physical Location Characteristics | Response |
|----|-----------------------------------|--|
| 1 | Distance from Closest Towns | Distance from nearest towns in miles GPS Coordinates Mon Repos 0.5 miles 6.8064° N, 58.0523° W Lusignan 1 miles 6.7908° N, 58.0442° W Beterverwagting 1.5 miles 6.8008° N, 58.0661° W La Bonne Intention 2 miles 6.7978° N, 58.0676° W |
| 2 | Settlement/Indigenous Communities | No indigenous communities are found nearby the Project Site. |
| 3 | Nearby Waterways/Creeks | Mon Repos Trench Atlantic Ocean |
| 4 | Predominant Land Use | Agricultural and Residential |

7. THE AREAS/ SENSITIVE RECEPTORS

There are no sensitive receptors such as daycares, schools, hospitals which will be affected by the proposed project in relation to the storing the nuclear density gauges at the said location.

8. ABUNDANCE OF NATURAL RESOURCES IN THE AREA

There is notably dense trees at the back part of the land. The Technical knowledge on specifics of the trees in the area are not known by GR Engineering Company at this time.

9. NON DISPUTED NATURE OF THE LAND FOR STORAGE OF GAUGES

The land is 1.3 acres of land found at Lot 144, 145 and 146 of the Backlands of Triumph, Agriculture Road. The land is owned by Gautam Singh Khan who uses it to store construction equipment for his business. The land is used commercially, and it lies within a section of Agriculture Road that are predominantly business laydown yards, agricultural areas and isolated densely forested areas and is scarcely populated. The property is also bordered by dense trees.

Mr. Khan has granted permission for GR Engineering Company to store their guages until a commercial plot has been assigned to GR Engineering Company from the Government of Guyana.

10. FEASIBLE ALTERNATIVE TO STORAGE OF DENSITY GUAGE AT AGRICULTURE ROAD

A feasible alternative to the current storage site is to acquire a commercial plot of land from the Government of Guyana. GR Engineering Company has submitted a proposal to the Central Housing and Planning Authority and has received a formal letter of receipt of our application. As soon as we get a feedback on the allocation of a commercial plot of land for GR Engineering Company we will indicate this to the Environmental Protection Agency. See attachment for letter of acknowledgment from the Central Housing and Planning Authority.

11. DESCRIPTION OF ANY EXISTING BASELINE INFORMATION AND CHARACTERISTICS OF THE RECEIVING ENVIRONMENT

GR’s annual dose limit for workers is 500mRem. Declared (in writing) pregnant workers are typically limited to 100mRem for the term of the pregnancy. Workers under the age of 18 are limited to 100mRem/yr.

The best way for us to describe baseline information as provided by the Manufacturer is to descibe how much millirems of radiation we are exposed to in our everyday lives. On average, man is exposed every year to 360 mrem per year. For Guyana, it may be less given that we are less industrialised than other countries, however, please see below for a table showing natural and man made radiation sources which we are exposed to:

| Radiation Source (Source: Humboldt Radiation Safety Guide) | Annual Dose (Per each year) |
|--|-----------------------------|
| Cosmic: From the Sun and other space sources and their reaction with the earth’s atmosphere. It increases 1 mrem for every 100 ft of elevation above sea level. | At sea level 27 mrem |
| Earth: From the natural radioactive materials in the ground. | 228 mrem |
| Housing: | |

| | |
|---|------------------------------|
| From the materials we use to build our homes and work places. Stone and brick or concrete house. | 7 mrem |
| Living: Eating, drinking, breathing Body; Aircraft Trip | 25 mrem 40 mrem 2 mrem |
| Man made: Weapons Medical Xray | 4 mrem 53 mrem |

Further to this, and based on our dosimeter monitoring (report is attached), the highest exposed dose for GR’s Senior Gauge Technician is 50 mrem for 2023. This falls way below the safe dose limit of 500 mrem per year as stipulated in the Company’s Radiation Safety Manual.

12. DECLARATION OF PREVIOUSLY APPLIED TO THE EPA FOR PERMIT/S AND LIST OF PERMITS THAT BELONG TO DEVELOPER.

GR has has never previously applied to the EPA for any other permit and thus, is not a holder of any EPA permit at this time.

13. LAYOUT OF THE PROJECT

A Layout of the project, represented on a map showing the following details is attached:

- a) an accurate indication of the project site position as well as the positions of the alternative sites, if any;
- b) closest town/, if any – Closest town is Mon Repos and Lusignan.
- c) names of major and minor access road/s to the site;
- d) identification of intake and/or discharge structures/locations for air, water and waste emissions and/or storage.

The map showing all of the above is attached to this Report.

14. DETAILED DESCRIPTION OF THE PROCESSES GENERATING DISCHARGES/EMISSIONS

Cesium -137 and Americum-241/Be are both radioactive materials found in the Nuclear Density Gauges owned by GR Engineering Company. These sources are very small and their activity is measured in millicuries or giga-becquerels.

| SOURCE | ACTIVITY | |
|-----------|----------|----------|
| Cs-137 | 10 mCi | .37 GBq |
| Am-241/Be | 40 mCi | 1.48 GBq |

Cesium-137 is the radiation source that the Gauges use to measure density. It extends from the bottom of the gauge to the desired depth. The depth of the test is based on the depth of the source rod. When not in use, the source is pulled up inside the gauge and is shielded by lead and tungsten carbide.

The Americum 241 Beryllium source is used to measure moisture and is located inside of the gauge. The source never moves.

Both sources are in a dual sealed stainless steel capsule. This means it is inside of a stainless steel capsule which is sealed by welding, and inside a second stainless steel capsule which is also sealed by welding. There is little possibility that that radioactive material can escape and contaminate the environment. Further to this, since its so hard for the radioactive material to escape the capsules, this significantly reduces the changes of the gauges radioactive material causing direct exposure. GR Engineering Company is NOT AUTHORIZED under any circumstances to remove or tamper with any of the sources within the gauges.

15. DOSE RATES FROM HUMBOLDT GAUGES

Two sources in the gauges when unshielded will have the following dose rates:

| Source | Activity | Dose rate @ 1 meter unshielded |
|--------|----------|--------------------------------|
| Cs-137 | 10 mCi | 3.3 mrem/hr |
| Am-241 | 40 mCi | 0.088 mrem/hr |

Whereas, total unshielded is 3.388 mrem/hr and total shielded is 0.2 mrem/hr.

Most of the contributions come from the Cs-137 source. When the source rod is in a safe position, the Cs-137 is shielded by heavy tungsten and carbide as mentioned above, thereby reducing the does rate. With this shielding, the combined whole-body dose rate is reduced to approximately 0.2 mrem/hr at a distance of one meter. Most of the exposure will occur to the user's ankle while the gauge is being carried.

TIME/DOSE

When the operator is using the gauge and it is powered on, he is in a radiation field from that source. The strength or dose rate of that field is measured in mrem per hour.

Example: The whole body dose while carrying the gauge is 0.2 mrem/hour. The operator does 20 tests per day, 5 days per week, 50 weeks per year, approximately three minutes each time, let's calculate his annual dose rate:

$$\text{Dose} = \frac{0.2 \text{ mrem} \times 3 \text{ mins/time} \times 20 \text{ times/day} \times 5 \text{ days/week} \times 50 \text{ week/year}}{1/60 \text{ hr/min}}$$

$$\text{Dose} = 50 \text{ mrem for one year.}$$

This is way below the annual dose limit of 500 mrem and is similar with the medical sector with exposure to xray technicians when using the xray machine.

RULES OF THUMB

Doubling the distance will reduce the dose rate to 1/4. Therefore, the farther you are away from the gauge the less the intensity and exposure is.

RISK – Source (Manufacturer – Humboldt)

Health risks from occupational exposure using a nuclear density gauge are much less than the risk associated with many other day to day activity.

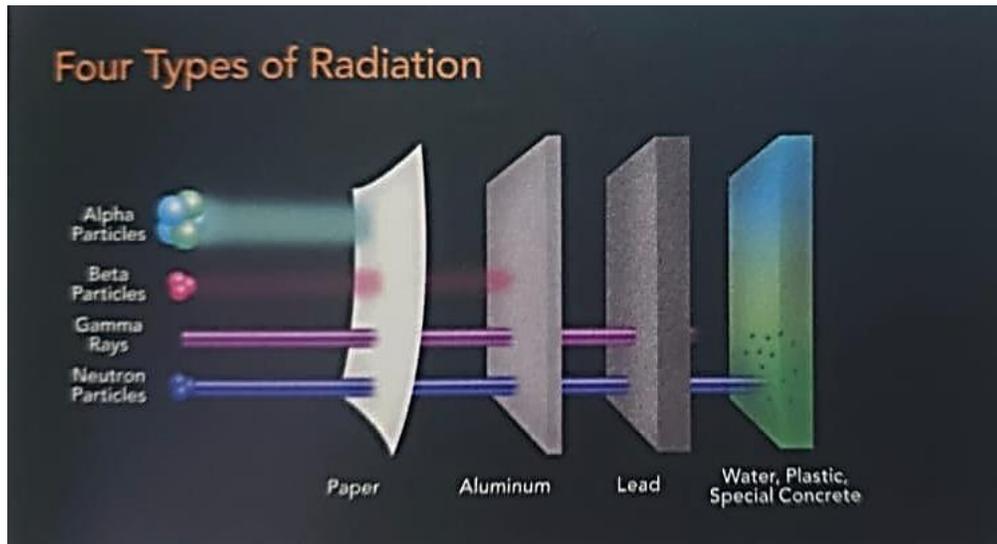
| Source | Days of Life Lost |
|---|-------------------|
| Smoking | 2370 |
| Overweight (20%) | 985 |
| Construction Worker | 302 |
| Agro Worker | 277 |
| Auto Accidents | 200 |
| Alcohol Drinking | 130 |
| Home Accidents | 95 |
| Manufacturing Worker | 55 |
| Occupational Worker (Gauge Technician or XRay Technician – exposed to 1 REM lifetime) | 1 |

16. SHIELDING

GR Engineering Company shall ensure that members of the public (MOP) are shielded from excessive levels of radiation. Excessive levels for a member of a public (MOP) individual are defined as $>100\text{mrem/year}$ or $>2\text{mrem/hr}$.

The boundary of the control area around the gauge is determined by a dose detection level that is $<2\text{mrem per hour}$ or $<100\text{mRem annually}$. The general rule of thumb for the minimum distance from the gauges to a full-time work station is 15 feet. The dose rate for a single gauge at 15 feet is $<0.05\text{mrem/hr}$. A person working a 40-hour week for a year at 15 feet away would receive a dose $<100\text{mrem/yr}$. The distance must be increased for multiple gauges.

Shielding can be used to reduce the intensity of radiation. Ideally, if room permits, use concrete blocks to dampen the intensity. Concrete blocks are an effective shield for both gamma and neutron radiation. Shielding effectiveness is expressed in half-value layers (HVL), which is a thickness measurement that reduces the radiation intensity by one-half for each thickness of a given shielding. Lead is an effective shielding for gamma but not for neutron. Polyethylene (plastic) is an effective shield for neutron. The Gauge transport cases are made from this material. Concrete blocks are effective for both. Stacking concrete blocks six feet high and two feet thick will dampen lateral intensity but not floor and ceiling intensity.



17. WASTE PRODUCTION

GR's gauge operations does not create any waste that should be concerning:

- 1) The Manufacturer has indicated that radiation does not remain in the ground after a density test has been conducted. The soil shields the gamma rays when the source rod is in the ground.
- 2) No chemical, liquid or solid waste matter is derived from conducted moisture density testing.
- 3) Lastly, the gauge uses 8 regular AA Batteries to power the monitor, these batteries are changed every 6 months. The batteries also do not evolve into a radioactive battery after remaining in the gauge for the 6 months.

18. DECOMMISSIONING PLAN

There is no certified disposal agency or institution in Guyana for disposal of nuclear density gauges. Therefore, for disposal or decommissioning, this will be done by exporting the gauge back to Humboldt Scientific Inc for gauge disposal services.

The EPA shall be contacted to acquire an export license for this purpose and Humboldt shall be contacted to broker the arrangements on the USA's end to make this possible. Humboldt has committed to taking any damaged or decommissioned gauges as seen in the letter enclosed.

A leak test is required to be conducted to ensure that the source is not leaking prior to transport.

19. POTENTIAL IMPACTS AND ITS SIGNIFICANCE

The greatest potential risk from the use and operation of the Nuclear Density Gauge is from Alpha and Beta radiation if the capsule containing a source is breached and the radioactive matter comes into contact with the skin, eyes or is ingested. Once ingested, these radioactive matter can cause cell damage. However, the chances of the capsule being breached is very unlikely.

Another potential impact is the nuclear gauges being stolen and discarded without a record trail to track the location, existence, use and or misuse of the gauge, particularly to prevent perpetrators from stealing a gauge, realising they cant use it and then they unknowingly discard it in a water way or dump site which can lead to exposure of the unsuspecting general public. GR Engineering Company, however, has appropriate mitigation measures for both of these risks.

20. IMPLEMENTED ENVIRONMENTAL MANAGEMENT AND MITIGATION MEASURES

Mitigation measures are as follows:

- 1. Safe use and operability and functionality of the guages**

GR Engineering Company ensures that all safe, effective and proven procedures for handling and maintaining our density gauges are adhered to. The company conducts leak tests every 12 months for each Gauge; Calibration is conducted every 24 months by the Manufacturer or an agent; and all standard operating procedures as required for good practice is done.

Apart from this, all Operators are provided with PPE, safety and security signage are placed around the gauge case and storage facility and dosimeters are used to measure radiation exposure.

2. Radiation Monitoring – Dosimetry and Survey Meter

GR uses dosimetry device (film badge) that measures the amount of radiation that each employee absorbs. This allows the company to ensure that each Gauge user is exposed to safe levels of radiation. Every 6 months, the dosimeters are sent to the USA to the Radiation Detection Company to test to see the levels of radiation exposure. The reports are monitored by the Radiation Safety Officer who is empowered to pull an individual from Gauge duties if exposures are high.

Additionally, GR Engineering Company uses a radiation survey meter to monitor environmental exposures regarding storing and using density gauges.

3. Care and Sensitivity for the environment and public;

GR Engineering Company takes pride and care for the environment and public. The company tries to be as discrete as possible when using our gauges, on site and when transporting, so as to not cause public disagreement from the misunderstanding of radiation and radiation safety.

4. Training - Authorized use only;

Initial and recurrent training must be given to all employees who work with the company gauges. The training plan utilized by GR Engineering Company is as follows:

- GR Nuclear Density Gauge Technician Training Course; - (Operators)
- Practical hands on training for gauge operators; - (Operators)
- APNGA Portable Nuclear Gauge Safety and US.DOT Hazmat Certification Training (Operators)
- GR Nuclear Density Gauge Awareness Training Course (Admin and General staff)
- APNGA Radiation Safety Officer Certification Training (Radiation Safety Officers)

Therefore, all staff are fully aware of how to safely handle the gauge and take care of themselves and the public when necessary.

5. Security

- a) When not in use gauges will be stored behind double-locked security that prevents unauthorized access or removal. The RSO must authorize and approve any operators

before they can remove gauges from storage. Any gauge and case removed from storage must be inspected.

- b) Gauges can never be left unattended at the work site. Gauges left in vehicles should be double-locked and concealed with appropriate bill of lading and emergency response sheets left on the driver's seat.
- c) Gauges cannot be left unsupervised with 3rd party gauge service personnel. If you have an individual from a gauge service company visit your facility to calibrate, service or repair your gauges you must have one of your authorized gauge operators accompany the individual at all times. They cannot be left alone with your gauges nor can they be left alone in the secured storage areas of the gauges.
- d) At all times, Gauge Operators are required to maintain control and constant surveillance of the portable gauge when it is in use and, at a minimum, use two independent physical controls to secure the portable gauge from unauthorized removal while it is in storage. The physical controls used should be designed and constructed of materials suitable for securing the portable gauge from unauthorized removal, and both physical controls must be defeated in order for the portable gauge to be removed. The construction and design of the physical controls should be such that they will deter theft by requiring a more determined effort to remove the portable gauge. The security procedures should ensure that the two physical barriers chosen increase the deterrence value over that of a single barrier, and that the two physical barriers would make unauthorized removal of the portable gauge more difficult.

6. Contingency Planning;

GR Engineering Company has response procedures for incidents of missing, stolen or damaged gauges which are found in the Company's Radiation Safety Manual.

21. SUMMARY OF MINUTES OF ANY PUBLIC CONSULTATIONS/ MEETINGS

A public consultation was not conducted by GR Engineering Company, however, the EPA's Officers conducted a visit to the proposed storage location on August 16, 2023 and spoke to a few residents around the area.

22. A DESCRIPTION OF ANY ASSUMPTIONS, UNCERTAINTIES AND GAPS IN KNOWLEDGE

There are no gaps to GR Engineering Company's knowledge or any concerns or uncertainty at this point.