GO NDE Inc.

PROJECT SUMMARY OUTLINE

REQUEST FOR APPROVAL TO IMPORT, STORE, TRANSPORT AND OPERATE INDUSTRIAL RADIOGRAPHIC EQUIPMENT (IR-192 GAMMA SOURCE) FOR THE GAS TO ENERGY PROJECT

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DATE : 11TH JULY 2023

GO NDE Inc.

SERVICES PROVIDED

GO NDE INC. offers a broad range of services to cater to all of its customers.

The following is a list of the services for the Gas to Energy Project (GTE Project):

1. Conventional NDE Inspection Services

- Radiographic Inspection (Gamma Ray & X-Ray)
- Magnetic Particle Inspection
- Liquid Dye Penetrant Inspection
- Ultrasonic Thickness & Flaw Detection
- Visual Inspection
- Heat Treatment Services (Pre Heat/PWHT)
- Hardness Testing
- Welding Procedure Qualification
- Quality Control/Quality Assurance Services

2. Advanced NDE Inspection Services

- Positive Material Identification (PMI)

EXPECTED TIMELINE:

This project is expected to begin in August 2023 and continue until July 2024.

DESCRIPTION OF PROPOSED PROJECT

GO NDE has finalized a contract with SICIM Guyana to provide Non Destructive Examinations for the Gas to Energy Project (GTE Project).

The organization intends to apply for approval for import, storage, transportation and use of Gamma Ray equipment (Iridium 192 / IR 192) for use on the GTE Project.

GO NDE plans to store the Iridium 192 at the Vreed-En-Hoop Shore Base located at West Bank Demerara. The Iridium 192 will be stored in a lockable, steel, lead lined storage box which will be secured in a 20ft Container at the shore base. The perimeter will be fenced and the relevant signage will be displayed so as to ensure persons are aware of the restricted area.
This storage unit will be located away from the major roadways and there are no immediate neighbours or residences.
The site will be monitored by 24 hour Security who will ensure that no unauthorized personnel access the area.

The Iridium 192 will be transported when required, to the different areas of the Gas to Energy Project in a lockable storage box that is secured to the back of a pick-up vehicle. Upon completion of the job daily, the Iridium 192 shall be returned to the storage area at the Vreed-En-Hoop Shore Base.

The following are the serial numbers of the IR-192 Isotopes that will be used for this project.

TT4889, TT4890, TT4891, TT4892, TT4893, TT4894, TT4895, TT4896, TT4897, TT4898, TT4899, TT4900

Due to the scope of work for this project which require specific isotope strengths, (70ci to 100ci), two new isotopes will be shipped every 45 days from the manufacturer to Guyana.
The route for shipment will be from Houston to Miami, then to Georgetown Guyana via Air Freight.
Upon receipt of the two (2) new isotopes, the two (2) that were in use on the GTE Project will be sent to Trinidad for continued used by the partner company.

PROJECT EXPLANATION

GO NDE Inc. intends to provide Radiographic Examination for the Gas to Energy Project in Guyana.

This method is widely used to examine for subsurface discontinuities (such as voids, porosity, inclusions and cracks, etc.) in castings and weldments in a wide range of materials, by using the technique of radiographic exposure and interpretation of radiographic film. **(Refer to Attachment # 1 – Radiographic Examination Procedure)**

The source capsule and the pigtail is housed in a shielding device referred to as a exposure device or camera. GO NDE utilizes 880 Delta source projectors which are portable, relatively lightweight and compact industrial radiographic exposure devices.

Photograph #1 below shows an 880 Delta source projector.

Photograph # 1

Taking into consideration the risks involved with its operations, GO NDE employs risk assessments and additional controls to ensure operations are completed in a safe manner and in the best interest of its customer, employees, the environment and the general public. **(Refer to Attachment # 2 - JSA for Radiographic Examinations)**

For this project, the organization ensures the following:

- Storage area constructed in accordance with international standards and double locked for additional security.
- Keys for storage are assigned to the ASNT Level II Technician who is also a Radiation Safety Officer.
- Logs track the movement of isotopes to and from jobsites.

It is important to note that radiographic examination operations will **NOT** be conducted at the storage site. All operations are conducted at approved client sites and is done in accordance with approved examination procedures.

PROJECT EXPLANATION con't

GO NDE Inc. utilizes Iridium 192 (IR 192) isotopes to conduct radiographic examination and IR 192 does not occur in nature. It is produced by neutron activation of iridium metal, usually in nuclear reactors and since the use of Iridium 192 are typically in sealed sources, release of Iridium 192 to the environment would be expected to be minimal and human exposure to iridium-192 would be limited to is beta emission rather than to the element itself.

Taking this into consideration, the organization ensures the following:

- Regular service and maintenance on exposure devices / cameras used for radiographic examination.
- Regular monitoring of isotope storage area.
- Ensuring only authorized personnel are allowed access
- All depleted isotopes are returned to the manufacturer / supplier for proper disposal.

POTENTIAL EFFECTS ON THE ENVIRONMENT

GO NDE INC. ensures due diligence in all of its operations and pays particular attention to managing the mitigation of all / any environmental risks. The organization has implemented preventative maintenance programs for its equipment thus preventing any impact to land and soil from its operations. The organization understands that radiographic examination is ranked as high risk and as such, for radiographic inspection equipment, wipe test / leak test are performed on the isotopes to ensure that the integrity on the equipment and isotope is not compromised. Surveys are also done around the isotope storage areas to ensure the isotopes are properly secured.

Depleted isotopes are returned to the manufacturer for disposal according to manufacturer requirements (in accordance with applicable regulations and shipped in approved sealed containers).

Our activities do not generate any air emissions (i.e. particulate emission such as dust or pollutant gaseous emissions) thus causing any impact to air. Also, our operations do not generate any noise or vibrations.

The organization's partner company has been providing radiographic examination services to the Oil and Gas Sector in Trinidad for the past thirty (30) years and environmental assessments conducted by the local Environmental Management Authority (EMA) has revealed that the operations pose no negative impacts to both ground and surface water.

POTENTIAL EFFECTS ON THE ENVIRONMENT (Continued)

Table # 1

CHEMICAL / CONSUMABLE	POTENTIAL ENVIRONMENTAL IMPACT (AS PER MSDS)	MITIGATION FACTORS
Iridium 192 Isotope	Iridium-192 does not occur in nature and is produced by neutron activation of iridium metal, usually in nuclear reactors. Since the use of iridium-192 are typically in sealed sources, release of iridium-192 to the environment would be expected to be minimal and human exposure to iridium-192 would be limited to its beta emission rather than to the element itself.	) Regular service and maintenance on exposure device / cameras used for radiographic examination.) Monitoring of isotope storage pit.) Only authorized personnel are allowed access.) Depleted isotopes are returned to manufacturer / supplier for proper disposal.

PLAN TO MITIGATE RADIATION EXPOSURE TO PERSONNEL AND THE PUBLIC

GO NDE in its effort to provide a safe workplace for its employees adopts its' implemented procedure as part of its safety policies to ensure protection of employees and the public from the hazards associated with Ionizing Radiation.

GO NDE ensures provision of instruction, guidance and training for its employees as it relates to Radiation and the prevention of potential injuries associated with this subject. This includes training on the necessary personnel protective equipment (PPE) which is provided by the organization and maintained within the preventative maintenance program.

The organization also monitors dosimetry records for all radioactive technicians and maintains records of results. This is done by an approved third party provider.

The HSE management system includes procedures for managing risk associated with radiation examination as well as other areas of operations.

GO NDE has implemented monitoring programmes to ensure that public exposure due to sources under its responsibility are adequately assessed and that the assessment is sufficient to verify and demonstrate compliance with regulatory bodies. This includes monitoring of the following, as appropriate:

(i) Leak tests conducted on all exposure devices to ensure non-contamination.

(ii) Depleted isotopes will be returned to Trinidad for continued use until they can be returned to the manufacturer.

FEASIBILITY

Historically, radiographic Examination (RT) has been the nondestructive testing (NDT) method of choice for inspection of critical welds in a variety of applications. By providing a pictorial, volumetric record of areas of interest, it was, and for some purposes still is, the best choice for many applications.

Radiographic examination is a widely accepted method of nondestructive testing (NDT) due to its ability to identify flaws such as cracks, thickness variations, corrosion, and material degradation with impressive precision. The main reason for this is simply that RT provides a permanent picture-either of the inspection that can be reviewed, audited and stored for years.

Technicians require a high degree of education, skill and experience and must be well-versed in radiographic examination safety procedures—both for the sake of their own well-being and in order to ensure compliance with legislations.

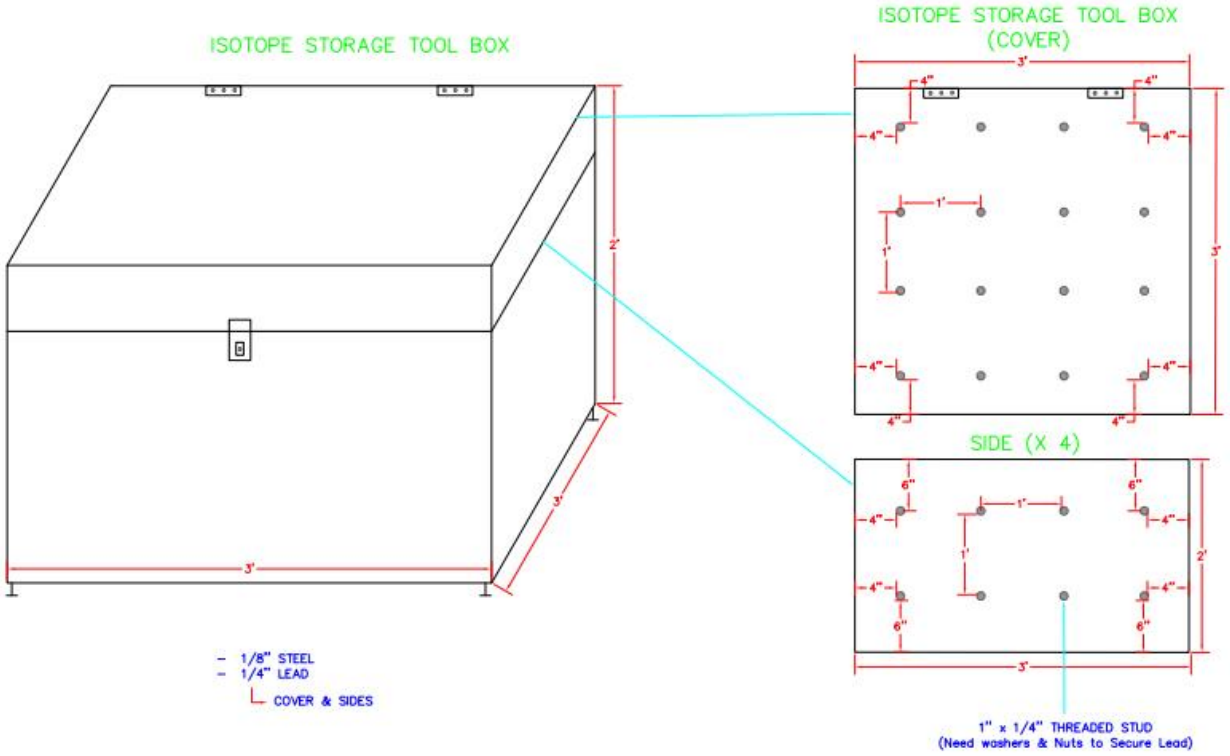
REQUIREMENTS FOR STORAGE OF EQUIPMENT & CONSUMABLES

As per the recommended guidelines of each associated MSDS, the following shall apply:

1) Gamma ray equipment – Iridium 192 - Stored in a lead lined tool box designed in accordance with IAEA-TECDOC-1145 (Section 6.2).

Photographs 1 and 2 showing storage containers

Photograph # 1 - (Sample Lead Lined Storage Box Design)



Photograph # 2 - (Sample Storage Unit)

SAFETY DURING MOBILIZATION & DEMOBILIZATION TO CLIENT SITE:

a) The crew leader verifies that all radiation workers are in possession of their personal TLD Badges.
b) Radiographic crew collects the Isotope (IR-192) from secured storage area. Prior to entering the storage area, the area is surveyed using a calibrated Survey Meter (ND 2000).
c) Once it is safe to enter the storage area, the Radiation worker, unlocks the storage unit and proceeds to survey the isotope.
d) The Isotope Log Book is then completed which gives details on the following:
   - The Date and Time the isotope is removed from the storage.
   - The Serial Number / Camera Number.
   - Location where the isotope will be used.
   - The Level 2 RT Technician responsible for the isotope.
e) The isotope is then removed and the storage unit locked and secured.
f) The isotope is placed in the storage box of the vehicle and locked.
g) The crew makes their way to the jobsite to perform inspection.
h) Upon completion of inspection the isotope placed in the storage box of the vehicle and locked. It is then returned to the storage area and the Isotope Log Book is updated with the time the isotope was returned to the storage area.

TRANSPORTATION OF RADIOACTIVE SOURCES

a) GO NDE Shall ensures that all vehicles transporting radioactive isotopes are equipped with a lockable metal box designed for transportation of sealed sources. This box must be located as far back as possible from the occupants during the road trip, in compliance with 49 CFR CH. 1: 177,870g and 49 CFR CH. 1: 173,448a. The certified technician ensures that the camera is locked and is placed in the vehicles' box. This box is locked to ensure that no unauthorized person will access the equipment. The camera must be stored only in the cargo compartment of the vehicle and must never be stored in any other compartment of the vehicle that is occupied by individuals. (49 CFR CH. 1: 177g)

b) The exposure container shall be marked with the radiation warning symbol. The date and strength of the isotope is available on the current decay chart for the respective source within the exposure camera.

c) Only certified ASNT Level I or Level II Technicians shall travel in vehicles transporting sealed radioactive isotopes. At all times, it is essential that a competent Level II RT / RPS Technician is present during transportation and storage. After ensuring that pre-cautions listed above are taken, the vehicle would leave the storage area and proceed to the relevant jobsite.

d) For vehicles transporting sealed radioactive sources, the dose rate shall not exceed:

- 10 mSv/h at any point on the external surface of any package or overpack and may only exceed 2 mSv/h provided that:

(i) The vehicle is equipped with an enclosure that, during routineconditions of transport, prevents the access of unauthorized persons.

(ii) Provisions are made to secure the package so that its position within the enclosure remains fixed in the vehicle during routine conditions of transport.

- 2 mSv/h at any point on the outer surfaces of the vehicle, including the upper and lower surfaces, or, in the case of an open vehicle, at any point on the verticalplanes projected from the outer edges of the vehicle, on the upper surface of theload, and on the lower externalsurface of the vehicle.

- 0.1 mSv/h at any point 2 m from the vertical planes represented by the outer lateral surfaces of the vehicle, or, if the load is transported in an open vehicle, at any point, 2 m from the vertical planes projected from the outer edges of the vehicle.

e) Upon arrival to the Clients' site, the crew obtains the relevant work permit and only then proceeds to remove the radioactive isotope from the vehicle's secured metal box and perform the required radiographic examination.

CONTINGENCY PLANS AS PER RADIATION SAFETY MANUAL

(Refer to Attachment # 3 – Radiation Safety Manual)

Plan A - Unauthorized Person/s Discovered in Controlled Area During Exposure.

- Terminate the exposure immediately.
- Request the name, address and employer of the person suspected being overexposed.
- Make a detailed sketch of the exposure setup, showing location and direction of radiation beam, position of exposed person, type and thickness of local shielding, (if any) e.g. brickwork or pipe racks, location of controlled area perimeter barriers and in particular warning signs and lights, measurements of all relevant distances.
- Determined by the interview, the length of time the person had been in this position inside the controlled area.
- In consultation with the company RPS, investigate and assess extent of the exposure to which the person may have subjected.
- If exposure is in excess of the relevant limit the suspected person and his RPS must be informed immediately.

N.B. During any of the following source recovery operations always remember never handle a sealed source directly with the hands.

Plan B - Sealed Source Holder Assembly Becoming Detached From Wind-Out Drive Cable / Control Cable during Exposure

- Check that all barriers, warning signs and lights remain in place and the barrier dose rate remains below 7.5uSv/h.
- Inform the site engineer or manager of the situation, advising of the need to maintain strict observance of the controlled area by all personnel, until the emergency is resolved.
- Pause for the appraisal of the situation before action.
- Assess the practicality of the plan in the light of any unforeseen complications. Calculate the stay time at the working distance for a maximum permitted dose of 5mSv. (See Appendix 2)
- Personnel involved in retrieval shall not to exceed the calculated stay time. If retrieval is not practical within the calculated stay time rotate personnel
- Ensure that a quartz fiber dosimeter is worn throughout retrieval operation in addition to the TLD, to confirm that the dose rate received is not in excess of that estimated, i.e.5mSv.
- Drive cable / Control cable should be fully extended to push the detached sealed source capsule to the end of the guide tube / source tube into the collimator.
- Attenuate the radiation by placing bags of lead shot over the sealed source capsule, checking its effectiveness with the survey meter.
- Check the effectiveness of the attenuation with a survey meter.
- Retract the drive cable / control cable.
- Disconnect the guide tube / source tube from the exposure container.
- Working quickly but carefully, with long handling tongs at arm's length, working up to a maximum stay time only, remove the guide tube / source tube from beneath the lead shot / lead bags. Attempt Gravitational removal of the sealed source capsule by manipulation of the guide tube / source tube with the tongs.
- Once removal has been effected, attenuate the sealed source capsule with lead shots / lead bags leaving the drive cable / control cable connection socket uncovered.
- Re-connect the drive cable and sealed source capsule, taking care not to disturb the lead shot / lead bag shielding the sealed source capsule.
- Remove the lead shot / lead bag and retire to the drive cable / control cable, wind in to fully retract the sealed source capsule into the exposure container.
- Check with the survey meter to ensure proper retraction then check the storage plug, disconnect drive cable / control cable form the sealed source capsule and lock the exposure container.
- If unsuccessful in retracting the sealed source capsule into the exposure container, place the sealed source capsule into the emergency retrieval container using the tongs for return to base (GO NDE Facility)
- Inform site engineer or manager that emergency is over.
- Liaise with the company RPS / HSE to assess estimated extent of dose and possible urgent TLD analysis.

N.B. **Exposure Container and drive cable / control cable must not be reused until faults investigated and cleared by manufacturer**.

Plan C - Sealed Source Becomes Jammed During Exposure and Will Not Retract Into Its Container, Most Likely Due to Jammed Mechanism or Damaged Guide Tube / Source Tube

- Check that all barriers, warning signs and lights remain in place and the barrier dose rate remains below 7.5uSv/h.
- Inform the site engineer or manager of the situation, advising of the need to maintain strict observance of the controlled area by all personnel, until the emergency is resolved.
- First attempt to dislodge the sealed source capsule by firm backwards and forwards movement of the drive cable / control cable unit handle. If successful, demobilize the equipment and eliminate cause of fault before reuse.
- If unsuccessful, retire to the barrier.
- Pause for appraisal of the situation before further action. Assess the practicality of the plan in the light of any unforeseen complications.
- Calculate the stay time at the working distance for a maximum permitted dose of 5mSv.
- Personnel involved in retrieval shall not to exceed the calculated stay time. If retrieval is not practical within the calculated stay time rotate personnel
- Ensure that a quartz fiber dosimeter is worn throughout retrieval to ensure that dose is not in excess of that estimate i.e. 5mSv.
- Using a survey meter, locate the position of the sealed source capsule in the guide tube / source tube.
- Attenuate the radiation by placing bags of lead shot over the sealed source capsule, checking its effectiveness with the survey meter.
- Return to the barrier and re-appraise the situation. Checks the doses received on the dosimeter and assess the practicality of the plan for complete source recovery within the remainder of the calculated stay time.

If the sealed source capsule will not retract past a visible buckle or kink in the guide tube:

- Fully extend the drive cable / control cable to position the sealed source capsule at the end of the guide tube / source tube into the collimator.
- Attenuate the radiation with lead shot / lead bags and check its effectiveness with the survey meter.
- Attempt to straighten out or repair the damage using pliers or a hammer, retire and try again to retract, if successful lock and demobilize the equipment.
- Inform site engineer or manager that emergency is over.
- Liaise with RPS / HSE to assess extent of dose and possible urgent TLD analysis.

Plan C - Sealed Source Becomes Jammed During Exposure and Will Not Retract Into Its Container, Most Likely Due to Jammed Mechanism or Damaged Guide Tube / Source Tube con't

- If unsuccessful, retract the sealed source capsule as far as possible without using excessive force, check its position with the survey meter and attenuate the radiation with lead shot / lead bags.

- Using the cable cutters, cut the guide tube / source tube as close to the collimator end stopper as possible, retire to the drive cable / control cable and extend the cable to wind the sealed source capsule completely out of the open guide tube / source tube.

- Using long handling tongs carefully insert the sealed source capsule into the emergency retrieval container, disconnect the sealed source capsule from the drive cable / control cable and secure the emergency container for return to base (GO NDE Facility)
- Inform site engineer or manager that emergency is over.
- Liaise with RPS / HSE to assess extent of dose and possible urgent TLD analysis.

<u>If the source will not retract due to jammed mechanisms:</u>

- Check for the position of the sealed source capsule in the guide tube / source tube using the survey meter and ensure attenuation of radiation with the lead shot / lead bags.
- Disconnect the guide tube / source tube from the exposure container to expose a discrete length of the drive cable / control cable.
- Remove guide tube / source tube using tongs to expose drive cable / control cable and sealed source capsule and attenuate source with lead shots / lead bags.
- Proceed to disconnect sealed source capsule from drive cable / control cable and place into the emergency retrieval container for return to base (GO NDE Facility)

- Inform site engineer or manager that emergency is over.
- Liaise with RPS to assess extent of dose and possible urgent TLD analysis.

N.B. During recovery operations involving cutting tools, care must be taken not to damage the sealed source capsule.

Plan D - Accident or Incident Involving the Possible Fracture of a Sealed Source Capsule and Leakage of Radioactive Contaminants.

- õ All personnel to evacuate controlled area immediately.
- õ Check and maintain barriers, signs and lights.
- õ Inform site manager of the situation advising of the need to maintain strict observance of the controlled area by all personnel until the emergency is resolved.
- õ Because of the danger of airborne contamination, no attempt should be made to approach the source, expert assistance is required and the immediate advice of the RPS must be sought.
- õ Do not eat, drink or smoke. Wash your hands and hand to avoid mouth contact. Try to keep all involved persons together in a limited area to avoid possible unnecessary spread of contaminating radioactive material.
- õ Maintain barrier supervision until the proper expert arrives to deal with the situation, and then act under his instructions.
- õ When the emergency is resolved liaise with the RPS concerning urgent medical examination and dose assessment.

N.B. In the event the accident involves trapped or injured persons then the rescue of those persons takes precedence over all other actions.

Plan E - Road Accident Involving a Vehicle Carrying Radioactive Material.

- Exposure and transportation containers are normally designed to withstand severe accident conditions, including fire. It must however, be assumed that the container is damaged and the source is exposed until it can be positively established otherwise.
- Monitor the container to establish any increase in the written transport index (dose rate at 1 meter.)
- If the dose rate is not in excess of the transport index, it can be assumed that the container has withstood the impact; nevertheless, it must be withdrawn from use for full examinations and clearance by the manufacturer.
- If the dose rate is in excess of the transport index then it must be assumed that the shielding is damaged and possible leakage of radioactive contents has occurred.
- The area must be immediately evacuated and barred off at the 7.5uSv/h distance, with appropriate warning signs and lights.
- Maintain barrier supervision until the proper expert arrives to deal with the situation and then act under his instructions.
- When the emergency is resolved, liaise with the RPS concerning urgent medical examination and dose assessment.

N. B. In the event the accident involves trapped or injured persons, then the rescue of those persons take precedence over all other actions

Plan F - Incident or Accident Involving a Radioactive Substance in Intense Fire.

- Exposure containers of the type normally used would comply with Type B requirements and should be capable of withstanding intense fire without damage. It must however be accepted that the possibility of damage does exist and action must be taken accordingly.
- Rewind source, if possible remove container from vicinity of the fire.
- Attempt to extinguish the fire using available fire fighting equipment. If this proves impossible then call the fire brigade (and police if the public are involved.)
- On the assumption that the container may be damaged, a controlled area must be established and barred off, with warning signs and lights. The barriers should as a matter of urgency, be first erected at an estimated safe distance at which the dose rate from the unshielded source would not exceed 7.5uSv/h.
- The controlled area must be evacuated and the barriers supervised to prevent unauthorized access.
- When the fire brigade arrives, the senior officer must be immediately informed of the potential radiation hazard.
- Maintain barrier supervision whilst the fire is being extinguished or act as instructed by the police if they are involved. All possible assistance must be given to the fire services throughout.
- When the fire is extinguished the container must be thoroughly inspected, including careful monitoring for any signs of damage or leakage. Should no damage or leakage be apparent, the container must be withdrawn from use for examination by the manufacturer.
- Should the container show signs of excessive dose rate it must be assumed possible leakage of contents has taken place, retire to the barriers and seek urgent assistance from the RPS.
- Maintain the barriers until the RPS has arrived and then act under his instruction
- When the emergency is over, liaise with the RPS concerning urgent medical treatment and dose assessment.

Plan G - Missing or Stolen Source.

If a Radioactive Source is missing, an immediate search using whatever radiation detection equipment that is available is conducted. If the source is not found within 1 hour, employee MUST inform the RPS and Company Management. The supplier, police and local regulatory bodies must also be informed. If a vehicle containing a source is missing, the police and senior RPS must be immediately informed.

Environmental Protection Agency - Guyana

ENVIRONMENTAL AUTHORISATION SCREENING REPORT

NAME OF COMPANY: GO NDE. INC

TYPE OF PROJECT: Transport, Storage and Use of Sealed Radioactive Sources

LOCATION OF PROJECT: Vreed- En- Hoop Shorebase, West Bank Demerara

PROJECT BACKGROUND

GO NDE Inc. applied to the Environmental Protection Agency (EPA) on **July 27, 2023**, for Environmental Authorisation to Store, Use and Transport Sealed Radioactive Sources at Vreed-En Hoop Shore base, West Bank Demerara, to support the Gas to Energy Project.

A verification inspection was conducted on **August 11, 2023**. The verification inspection confirmed the following:

1. The Storage facility has already been prepared for housing the sources.
2. The information submitted was evident and consistent on site.
3. Safety and Security measures met the International Atomic Energy Agency (IAEA) Safety Standards and Security Guidelines.
4. Environmental impacts are minimal.

PROJECT DESCRIPTION

GO NDE Inc. aims to conduct radiographic examinations for Guyana's Gas to Energy Project. The project involves detecting internal defects like voids, porosity, inclusions, and cracks within various materials through radiographic exposure and film interpretation. GO NDE Inc. will employ Iridium 192 (IR 192) isotopes for radiographic testing to achieve this. These isotopes are contained in IR 100 Projectors, industrial devices that position and project the radioactive source onto objects to create radiographic images. These projectors comprise a housing for the radioactive source, shielding for radiation control, and mechanisms for precise source positioning. The project encompasses source storage at the Vreed-En-Hoop shore base, transportation to the gas-to-energy project site, and utilisation of radiographic sources at the GTE pipeline path.

PHASES OF THE PROJECT

The storage facility, which is specifically designed to house sealed sources, has been installed successfully. Nevertheless, the operational functionality of this facility is currently on hold, awaiting official approval for the storage of sources and their subsequent utilisation at the Gas to Energy sites. This delay is due to the necessity of regulatory clearance before the facility can become fully operational and facilitate the storage, transport and use of sealed sources.

Operational Phase

During the sanctioned period, this project phase will span twenty-four (24) consecutive months and involve a workforce of twelve (12) employees. The operational phase encompasses the following key aspects:

Storage

The Iridium-192 sources, when not in use, will be stored at the Vreed-en-Hoop shorebase in West Coast Demerara.

The Iridium-192 sources will be stored for safety at the storage site within a secure, lockable, steel, lead-lined storage box. This storage box will be inside a twenty-foot (20ft) container at the shore base. The storage area is fenced and marked with relevant signage. Security measures include 24-hour surveillance and cameras to prevent unauthorised access. Regular physical inspections of exposure containers and equipment will be conducted quarterly, recorded with a survey meter to check for contamination. Sources will be tested every six months for removable contamination exceeding 0.005 microCi; contaminated equipment is addressed. Access keys to the storage facility are exclusively held by the Level II Radiographer/Radiation Safety Officer, ensuring controlled access to the sources.

Transport

Adhering to the recommendations of the IAEA, strict procedures will be followed for transporting the sources to the site. These measures include visibly displaying warning signs on vehicles, utilising secure containers, having certified technicians oversee security, and ensuring thorough labelling.

Use

Upon arrival at the designated site, the Iridium-192 source will be securely placed within its projector. This assembly will then be firmly attached to the component's surface intended for examination. Positioning the source at an optimal distance guarantees the desired image quality. The exposure time for radiography is meticulously calculated to achieve the right balance between contrast and sensitivity. It is imperative to fix the camera to prevent unintended movement during exposure securely. Upon activation, the source emits gamma rays that penetrate the component, interacting with the film or digital detector on the opposite side. This interaction effectively captures an image, ready for in-depth analysis and evaluation.

Ensuring the safety and accuracy of radiographic examinations involves multiple precautions. A protective barrier is established to maintain radiation below 0.75 mR/h. Demarcation barriers and warning notices prevent unauthorised access, bolstered by rigorous entry checks. Radiation control entails using a beam collimator and local shielding. Unlocking the exposure container is allowed

only after proper preparation and evacuation. Ongoing monitoring with a survey meter guarantees adherence to radiation limits. A controlled perimeter, marked by signs, guides personnel, while Simultaneous Operations (SIMOPS) guidelines enhance safety. In cases where cordoning is challenging, inaccessible areas are roped off and vigilantly overseen by a designated barrier watch to thwart unauthorised entry.

PROJECT LOCATION

The Project's Storage is located at Vreed- en-hoop shore base, West Coast Demerara, in an area characterised for Industrial use. In proximity, about 416.59 meters to the south, lies the Mangrove ecosystem. To the facility's north is the Atlantic Ocean, while the access road and the Atlantic Ocean are located to the west. On the opposite side of the operation, to the east, there is the storage facility's support office.

Figure 1: Google image showing the location of the Go NDE inc. Radiation Storage facility

CHARACTERISTICS OF POTENTIAL IMPACTS

Air Pollution

The facility intends to utilise a Pickup Truck (2022 Toyota Hilux Rocco vehicle) for daily transportation of resources from the storage site to operational sites. This activity has the potential to release greenhouse gases, such as carbon dioxide, into the atmosphere during fuel combustion, with an annual estimated fuel consumption of 475.5 gallons (GO NDE Inc., 2023).

Mitigation Measures

The relatively new vehicle (2022 Toyota Hilux Rocco) is expected to have optimised performance, such as enhancing airflow and reducing drag, ultimately leading to lower fuel consumption. In addition, the permit's condition will specify regular servicing of vehicles to optimise engine performance, thereby reducing fuel consumption and emissions. Additionally, there will be a speed limit imposed within the operational permit to eliminate unnecessary acceleration, as higher speeds result in increased fuel consumption. According to the Australian Department of Infrastructure, Transport, Regional Development, Communications and the Arts, a car can use up to 25% more fuel at 110 km/h compared to 90 km/h.[1]

Impact Significance

Implementation of these measures is expected to reduce the environmental impact of air pollution significantly.

Noise Quality & Vibration

The facility intends to utilise a 2022 Toyota Hilux Rocco vehicle for daily transportation of resources from the storage site to operational sites, and noise is anticipated from such activities.

Mitigation Measures

The optimised performance of the relatively new vehicle, specifically in enhancing airflow and reducing drag, tends to result in quieter operation. Regular servicing, which will be mandated by the permit conditions, ensures that the engine functions smoothly, potentially reducing mechanical

[1] Australian Department of Infrastructure, Transport, Regional Development, Communications and the Arts. (2023). Reducing your emissions. Retrieved from https://www.greenvehicleguide.gov.au/pages/UnderstandingEmissions/TipsToReduceYourEmissions

noise. Furthermore, the imposed speed limit within the operational permit not only lowers fuel consumption but can also mitigate noise, as higher speeds typically generate more vehicular noise.

Impact Significance

No significant impact will occur. The comprehensive approach to optimising vehicle performance and regulating speed has the potential to have a positive impact on minimising noise pollution during transportation activities.

Water Quality

Discharge film processing chemicals (developer and fixer) into waterways. The film developer contains chemicals such as hydroquinone and metol, while the fixer contains sodium thiosulfate. If these chemicals were to be released into a natural water system in large quantities, it could potentially affect water quality. The mentioned chemicals pose risks to aquatic ecosystems. They have the potential to be toxic to aquatic organisms, including fish and invertebrates, disrupting the ecological balance. Additionally, their release can lead to bioaccumulation in the tissues of aquatic organisms[2], transferring toxins through the food chain. The chemicals can also alter water chemistry, affecting crucial parameters like pH levels. Overall, their introduction has the potential to disrupt ecosystems and cause long-term ecological damage.

Mitigation Measures

Effluent will be treated before being released into waterways using the following procedures:

1. The fixer is placed in the silver recovery unit, which filters the chemical for Twenty (24)) hours to remove the silver content of the liquid.
2. The fixer is filtered using the REPACK cartridge before entering the storage tank for disposal.
3. One gallon of fixer and one gallon of developer is then mixed together and diluted with 248 gallons of water within the storage tank.
4. Oxygen is also pumped into the diluted solution for twenty-four (24) hours.
5. The sample will be taken by an approved and certified laboratory to ensure that the chemical for disposal meets the requirements of the EPA, such as Temperature, Dissolved oxygen, PH, Chemical oxygen demand, and total suspended solid.
6. Once the chemicals meet the required standard, they shall be released into the environment through natural waters.
7. The fixer is filtered using the REPACK cartridge before entering the storage tank for disposal.

[2] Enguita, F. J., & Leitão, A. L. (2013). Hydroquinone: Environmental pollution, toxicity, and microbial answers. *Biomed Res Int*, 2013, 542168. https://doi.org/10.1155/2013/542168. PubMed ID: 23936816; PubMed Central ID: PMC3727088.

8. One gallon of fixer and one gallon of developer is then mixed together and diluted with 248 gallons of water within the storage tank.
9. Oxygen is also pumped into the diluted solution for twenty-four (24) hours.
10. The sample will be taken by an approved and certified laboratory to ensure that the chemical for disposal meets the requirements of the EPA, such as Temperature, Dissolved oxygen, PH, Chemical oxygen demand, and total suspended solid.
11. Once the chemicals meet the required standard, they shall be released into the environment through natural waters.

Impact Significance
No significant impact will occur.

Disused Sources

Iridium sources will become depleted and, therefore, will require disposal.

Mitigation Measure
Depleted Irridium sources will be sent to Industrial Nuclear Co Inc. in Trinidad and Tobago for disposal.

Impact Significance
Minimal impact is anticipated since there will be no sources stored in the country after it has been used.

Waste Management

Radiographic films will be sent to Trinidad and Tobago for disposal. Depleted film processing chemicals are generated through radiographic image processing.

Mitigation Measures
Depleted processing chemicals will be collected and stored in chemical containers at the facility, where it is treated and then released into waterways.

Impact Significance
Minimal impact is anticipated since water is treated before being released into the environment.

Radiation Exposure

The International Energy Agency characterised the Iridium 192 source that the operation will utilise a category 2 source. If not safely managed or securely protected, this source could cause

permanent injury to a person who handled it or was otherwise in contact with it for a short time[3]. Being close to this amount of unshielded radioactive material could be fatal for hours to days.

Mitigation Measures

The facility utilises the three primary techniques for reducing the dose received from a radiation source as recommended by the IAEA: time, distance and shielding.

Time

The exposure device is unlocked briefly during the radiographic examination. Within this time frame, a beam collimator is employed to precisely direct gamma radiation towards the subject under examination, ensuring it is focused and contained without dispersing into the environment.

Shielding

Certain materials can weaken (or attenuate) ionising radiation. The amount of attenuation depends on the specific material and its thickness.

1. Sealed: The source is mainly housed in an exposure device, none as a projector, which provides shielding and containment for the radioactive source, reducing the radiation exposure to surrounding areas and personnel.
2. Storage**:** The Iridium-192 sources are stored within a lockable, steel, lead-lined storage box. This box is placed within a 20ft container at the Vreed-en-Hoop shore base. These measures provide shielding to contain and protect the radioactive sources.
3. Operation: The procedure involves the utilisation of a beam collimator and local shielding to reduce radiation intensity. These shields contribute to preventing excessive radiation exposure to personnel.
4. Transportation: The exposure container for transporting the radioactive isotopes carries warning symbols and is secured within a lockable metal box at the rear of vehicles. This container serves as shielding to prevent unnecessary radiation exposure during transportation.

Distance

Ionising radiation adheres to the inverse square law, meaning that doubling the distance from radiation sources reduces the dose rate by a factor of 4.[4]

1. Storage: The storage area is a restricted zone where unauthorised individuals are prohibited from accessing the facility, ensuring they remain at a considerable distance from the storage area.
2. Operation: The process commences by setting up a protective barrier at a secure distance from the radiation source to maintain the dose rate below 0.75 mR/h. At this distance, demarcation barriers with warning notices and flashing lights prevent unauthorised entry. After this initial barrier, a controlled perimeter, reinforced with signs, is established to regulate restricted areas.

[3] INTERNATIONAL ATOMIC ENERGY AGENCY, Categorization of Radioactive Sources, IAEA Safety Standards Series No. RS-G-1.9, IAEA, Vienna (2005).

[4] Kim, J. H. (2018). Three principles for radiation safety: time, distance, and shielding. Korean Journal of Pain, 31(3), 145-146. https://doi.org/10.3344/kjp.2018.31.3.145

3. Transportation: During transportation, the sources are enclosed within shielding and positioned safely from passengers within the cargo.

The IAEA also emphasises the importance of security, which has been implemented to restrict facility access to authorised personnel.

1. Storage: The Iridium 192 sources are securely stored within a lockable, steel, lead-lined storage box. This storage box is placed within a 20ft container at the shore base. Access is restricted to the Radiation Safety Officer, and the area is enclosed by a fence and equipped with relevant security signage. Additionally, 24-hour surveillance and cameras ensure continuous monitoring of the storage site and the container's surroundings.

2. Operation: Demarcation barriers featuring warning notices and flashing lights are in place to prevent unauthorised entry.

3. Transportation: Security measures extend to transportation. Vehicles tasked with transporting radioactive isotopes must be equipped with a lockable metal box at the rear, guaranteeing container security during transit. Certified technicians oversee container security throughout the transportation process.

Impact Significance

The mitigation measures encompass multiple aspects, including time, distance, shielding, and security. Given the comprehensive range of mitigation measures, the impact significance of using the Iridium-192 source is effectively minimised.

PROJECT SIGNIFICANCE

i. Criterion 1 Project Location

The Project is located at Vreed-En-Hoop Shorebase, West Bank Demerara, in an area characterised by industrial operations.

ii. Criterion 2 Environmental Sensitivity

The storage facility is positioned at a distance of approximately 416.59 meters from the mangrove ecosystem. At this range, radiation levels are anticipated to be sufficiently minimal to preclude any discernible impact on the said ecosystems. Moreover, the established distance surpasses the buffer distance recommended by the International Atomic Energy Agency (IAEA), which is set at 30 meters.[5] Consequently, the mangrove ecosystem is expected to remain unaffected by the operational activities. Similarly, during transportation, there is no anticipated impact on public safety, as the radioactive sources will be securely enveloped within three layers

[5] [5] IAEA. (2013). *Sealed Radioactive sources.* Austria: IAEA.

of shielding: the shielded source itself, the photographic enclosure, and a shielded lead box for the duration of transportation. The Atlantic Ocean is also located to the north of the facility.

Criterion 3 Levels of Public Concern:

There is public concern regarding the use of radiation sources near residential areas. However, since the sources will primarily be stored at the Vreed-en-Hoop shore base, an industrial site, these concerns will likely be diminished.

SUMMARY OF IMPACT SIGNIFICANCE

Impact	Significance	Summary of Reasons
Air Pollution	**Not Significant**	Implementation of mitigation measures is expected to reduce the environmental impact of air pollution significantly.
Noise Pollution	**Not Significant**	No significant impact will occur. The comprehensive approach to optimising vehicle performance and regulating speed has the potential to have a positive impact on minimising noise pollution during transportation activities.
Water Pollution	**Not Significant**	Film Processing Chemicals will be treated before being released into waterways.
Waste Management	**Not Significant**	Depleted Irridium sources and radiographic films will be sent to Trinidad and Tobago for disposal, and depleted processing chemicals will be treated before release.
Radiation Exposure	**Not Significant**	The mitigation measures encompass multiple aspects, including time, distance, shielding, and security. Given the comprehensive range of mitigation measures, the impact significance of using the Iridium-192 source is effectively minimised.

CONCLUSION AND RECOMMENDATION

Following the technical review of all existing data surrounding this Project, observations/field inspections, and the exercise of discretion, it was determined that establishing this Project at the proposed location will **not significantly** impact the surrounding environment. An Environmental Impact Assessment (EIA) is not required.

Therefore, the Project should be placed on 30 days' Public Notice. Barring any concerns from the public surrounding the operation of the Project at its current location, it is recommended that the Project be permitted to transport, store, and use sealed radioactive sources.

PICTURES

PICTURES

Figure 1: Storage area, Vreed-En-Hoop shore base

Figure 2: The Lead Lined Storage Box

Figure 3: The interior of the lead-lined Storage Box

Figure 4: Radiation Survey meters

Figure 5: Interior of the Storage Container

Figure 6: The current signage at the facility